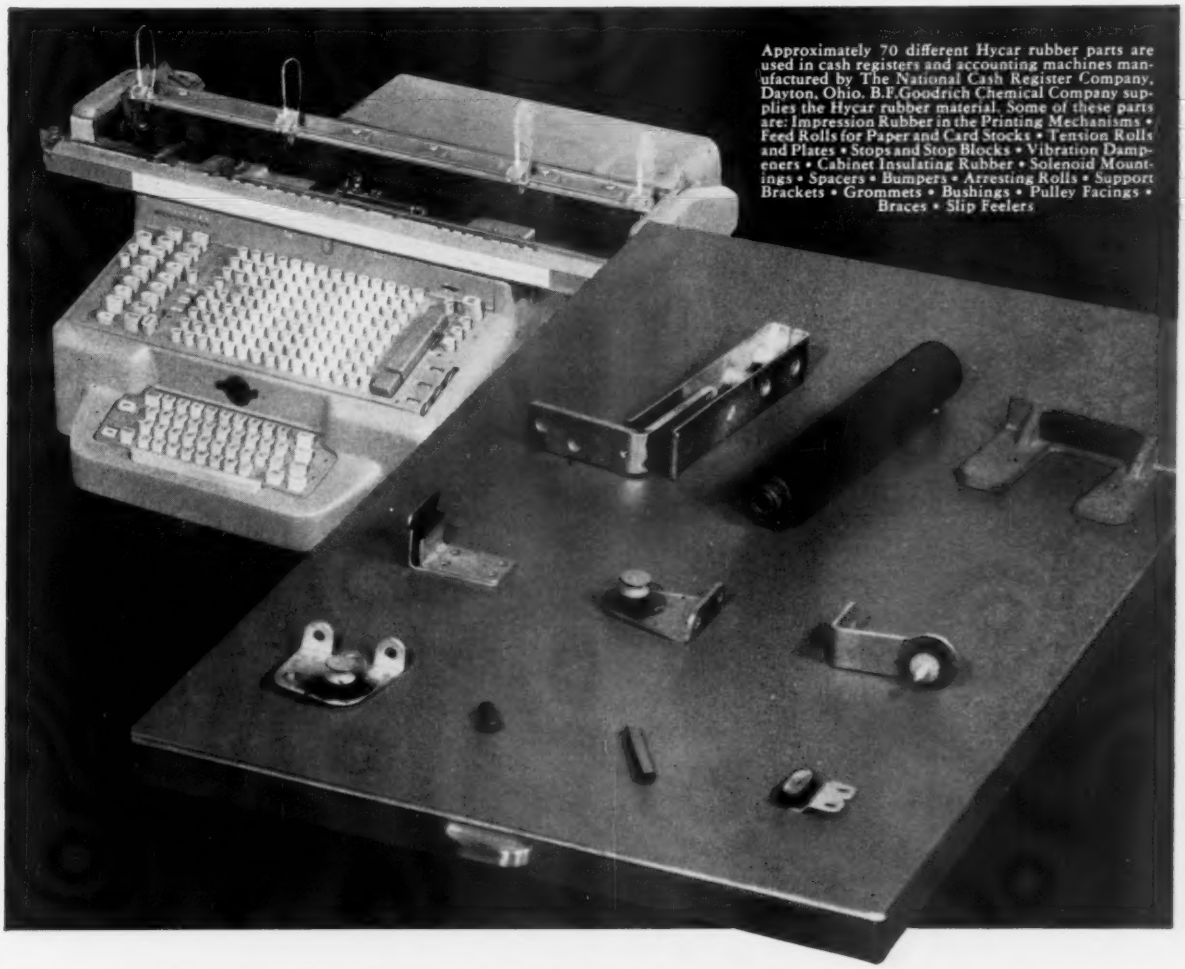
News about

B.F.Goodrich Chemical *raw materials*



Approximately 70 different Hycar rubber parts are used in cash registers and accounting machines manufactured by The National Cash Register Company, Dayton, Ohio. B.F.Goodrich Chemical Company supplies the Hycar rubber material. Some of these parts are: Impression Rubber in the Printing Mechanisms • Feed Rolls for Paper and Card Stocks • Tension Rolls and Plates • Stops and Stop Blocks • Vibration Dampeners • Cabinet Insulating Rubber • Solenoid Mountings • Spacers • Bumpers • Arresting Rolls • Support Brackets • Grommets • Bushings • Pulley Facings • Braces • Slip Feelers

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Hycar nitrile rubber has made possible the development of many new products and the improvement of existing products. For information, write Department KA-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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American Rubber

B.F.Goodrich Chemical Company

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Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

MARCH, 1958 VOL. 82 NO. 6

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1016 **Compounds for High Temperature Fuel Seals**—By E. J. Fujiwara, W. G. Lajiness, L. C. Smith and R. G. Spain

Testing the properties of elastomers designed to operate at high temperatures while immersed in aircraft fuels.

1021 **Determination of Tire Tread and Tread Rubber Profile**

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1024 **Thermal Diffusivity of Butyl Rubber and Its Compounds: Part II. Application of the Diffusivity Coefficients**—By Donald R. MacRae and R. L. Zapp

How to apply coefficients to typical vulcanization problems such as temperature at the center of a slab.

1031 **Equivalent Cures in Specimens of Various Shapes**

A special industry report covering the results of an investigation into the problem of equivalent cures by an appropriate ASTM task group.

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Highlights Sidelights *of the News . . .*

March, 1958

ASTM Committee Week, held this year in St. Louis, Mo., included an interesting meeting of Committee D-11 on Rubber and Rubberlike Materials as well as a symposium on "Ozone Problems" . . . Other activities of interest included meetings of Committee D-24 on Carbon Black and Committee E-1 on Methods of Testing . . . The ozone symposium attracted more attention than any similar event in recent years (page 1034).

The Japan Synthetic Rubber Co., organized as a semi-governmental concern in December, 1957, has announced plans to construct a synthetic rubber plant at Yokkaichi, a major petrochemical manufacturing center . . . The plant is scheduled to be in operation by early 1960 with an annual production of 30,000 tons of styrene rubber . . . Additional capacity can be added if necessary (page 1055).

United States District Court at Cleveland has ruled in favor of the Sun Rubber Co. finding that the National Latex Products Co. and the Akron Presform Mold Co. infringed valid patent rights on machinery and manufacturing methods owned by Sun . . . Two patents are involved, one covering a method of making hollow articles, while the other covers the machinery for making the articles (page 1053).

Firestone Tire & Rubber Co. has denied charges brought by the Federal Trade Commission that the company misrepresented facts in its tire advertising . . . FTC has charged that Firestone had been advertising second-line tires as first-line equipment . . . Firestone answers that it has delivered to the buying public exactly what the company advertised (page 1057).

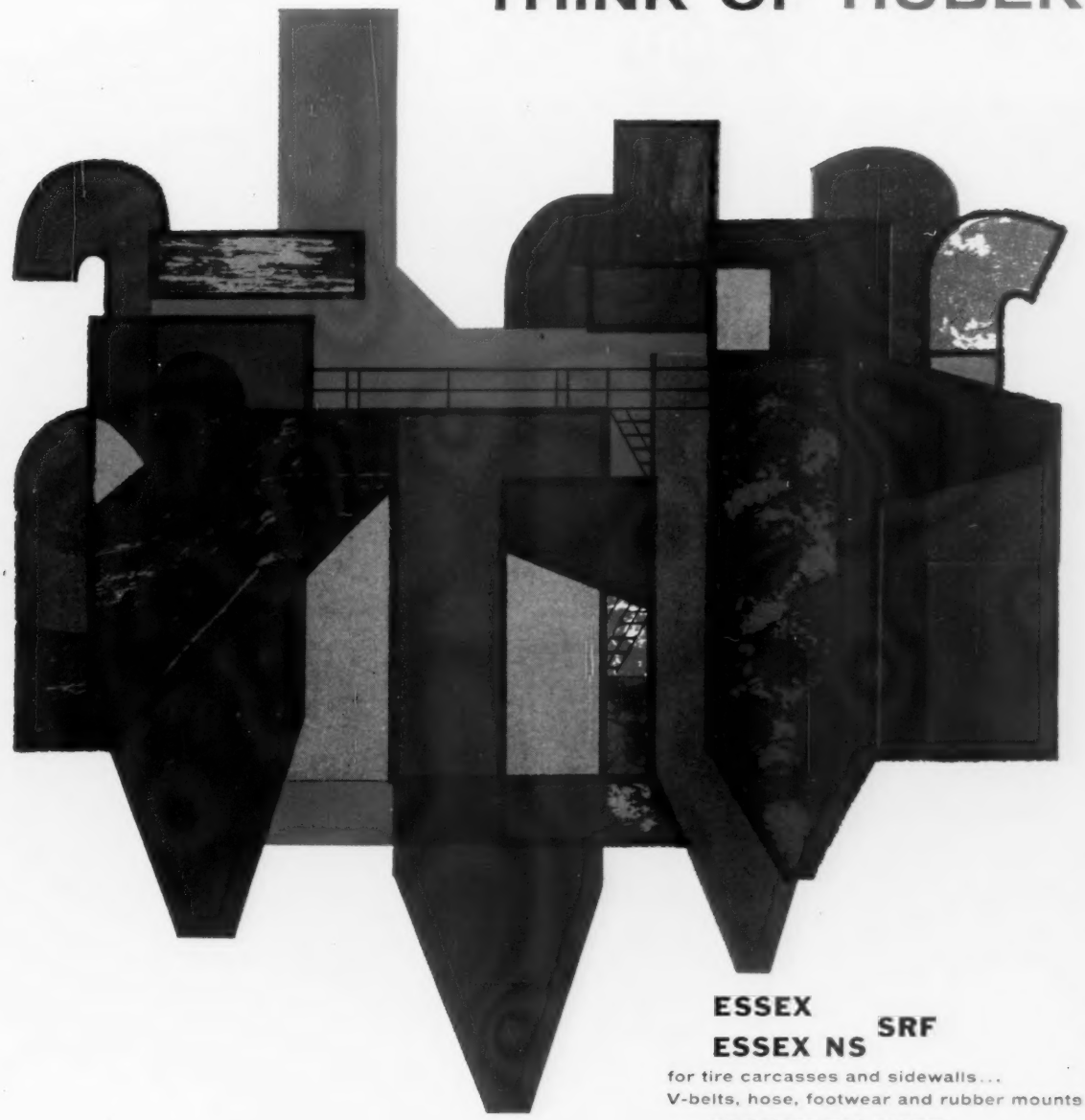
Polymer Corp. of Canada, Ltd., has announced a 1958 capital budget of $10 million to complete projects underway and to cover initial expenditures for additional expansion intended to increase production . . . Some of the projects involve a new butadiene facility, a research laboratory addition, a new latex plant, and an additional rubber finishing line (page 1058).

Among the interesting meetings reported on in this issue: ISO/TC45 in Zurich (page 1047) . . . SAE-ASTM Technical Committee on Automotive Rubber in Detroit (page 1059) . . . Southern Rubber Group Winter Meeting in Houston, Texas (page 1044) . . . Washington Rubber Group Special Decennial Celebration Meeting (page 1048).

Who is "Man in the News" This Month?
For another in the new series devoted to a recognition of outstanding industry figures turn to page 1046.

for rubber reinforcing pigments

THINK OF HUBER



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V-belts, hose, footwear and rubber mounts

MODULEX HMF
tire carcasses, sidewalls, undertread and butyl tubes

AROGEN GPF
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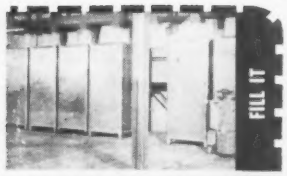

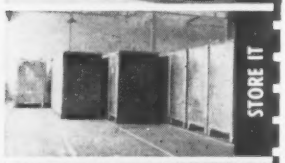

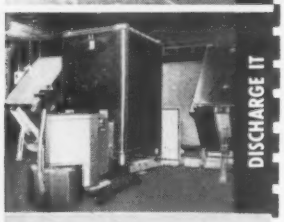

offers every one of these important advantages

Tote System is a complete, mechanical, automatic bulk handling system. It is based on metal bins—aluminum, stainless or carbon steel, monel, or magnesium—plus filling and discharging equipment. Here is what it will do:

1. Tote System effects important economies by eliminating recurring container costs; eliminating product loss, contamination and deterioration; reducing labor and handling costs; reducing warehouse storage space requirements; and preserving original product quality.
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4. Tote System permits you to weigh incoming materials as a check against invoice weight, and for a permanent inventory record.
5. Tote System permits the use of a minimum, uncomplicated conveyor system with an accompanying reduction in clean-up and maintenance time.
6. Tote System, in handling food products, meets the requirements of all existing sanitation codes.
7. Tote System permits complete transportation flexibility. Tote Bins can be shipped by rail** or truck, or they can be left in the plant and filled from hopper cars or trucks.
8. Tote System can be adapted easily to future requirements. Plant layouts can be changed simply by re-locating discharge stations. Operations can be expanded merely by procuring additional Bins. And Bins can be used interchangeably for different products.
9. Tote System, in small and medium sized installations, requires no more labor to operate than a fixed storage bin system. In extremely large installations, another man may be required, but, in most cases, his time is more than offset by the elimination of highly-paid electronic experts needed to maintain and operate complicated fixed bin storage and conveying systems.

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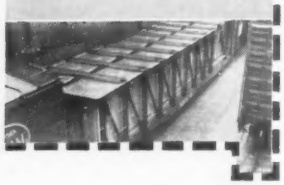

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Letters to the editor

With the publication of the RUBBER RED BOOK we receive many letters commenting upon the directory. The letters which follow indicate the sentiments expressed by some of our readers —Editor.

. . . will prove to be of considerable usefulness.

A. K. CRANSTON
Bata Shoe Co. of Canada, Ltd.,
Batawa, Ont., Canada

. . . makes a most valuable addition to our library.

A. G. PAWSON
Secretariat of the International
Rubber Study Group,
London, W.C.2, England

. . . a superlative achievement and I, for one, again congratulate you on your continuing to surpass yourself.

ARTHUR NOLAN
Latex & Rubber, Inc.,
Baltimore 30, Md.

. . . we expect to use it much more than we will any other six reference books put together.

K. J. SOULE
Manhattan Rubber Division,
Raybestos-Manhattan, Inc.,
Passaic, N. J.

. . . we . . . hold this valuable directory in high esteem.

GEORGE E. GROVE
New Jersey Zinc Co.,
160 Front St.,
New York 38, N. Y.

. . . it is really a significant job. The cross-indexing could hardly be improved upon.

CHARLES R. HAYNES
Carter Hill,
Clinton, Conn.

. . . it is getting to be bigger and better. Within the past ten days we at Dryden have referred to the RUBBER RED BOOK at least six times . . .

H. A. WINKLEMANN
Dryden Rubber Division,
Sheller Mfg. Corp.,
Chicago 24, Ill.

. . . will be of considerable assistance to us . . .

THOMAS SUMNER
University of Akron,
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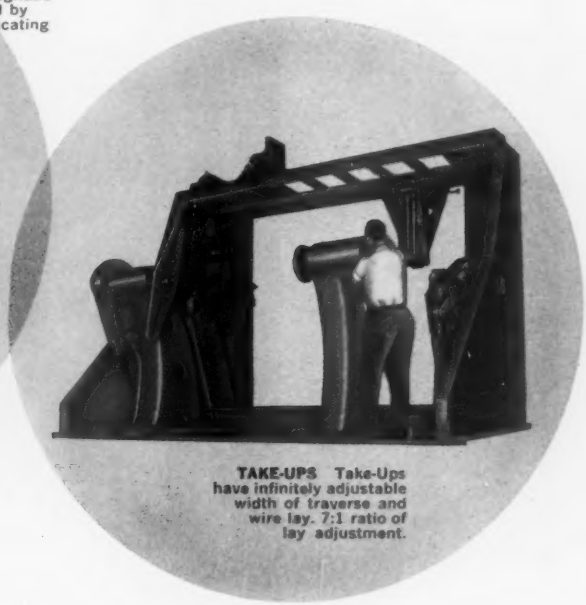

TAKE-UPS Take-Ups have infinitely adjustable width of traverse and wire lay. 7:1 ratio of lay adjustment.

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the best way known to assure flawless whitewalls

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is your protection against

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For less than ½¢ per whitewall tire you can add the small amount of Ko-Blend necessary to reduce rejects and reworks to a minimum. Ko-Blend is a latex-compounded masterbatch containing 85% insoluble sulfur which has been colloidally dispersed in GRS latex.

The extremely short milling time necessary to incorporate Ko-Blend makes it possible to maintain high Mooney viscosity in whitewall stocks while overcoming processing difficulties encountered when other types of sulfur are used. For samples and further information on how Ko-Blend eliminates spots, streaks and batch softening, write to:

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Chemical Division
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Creating Progress Through Chemistry

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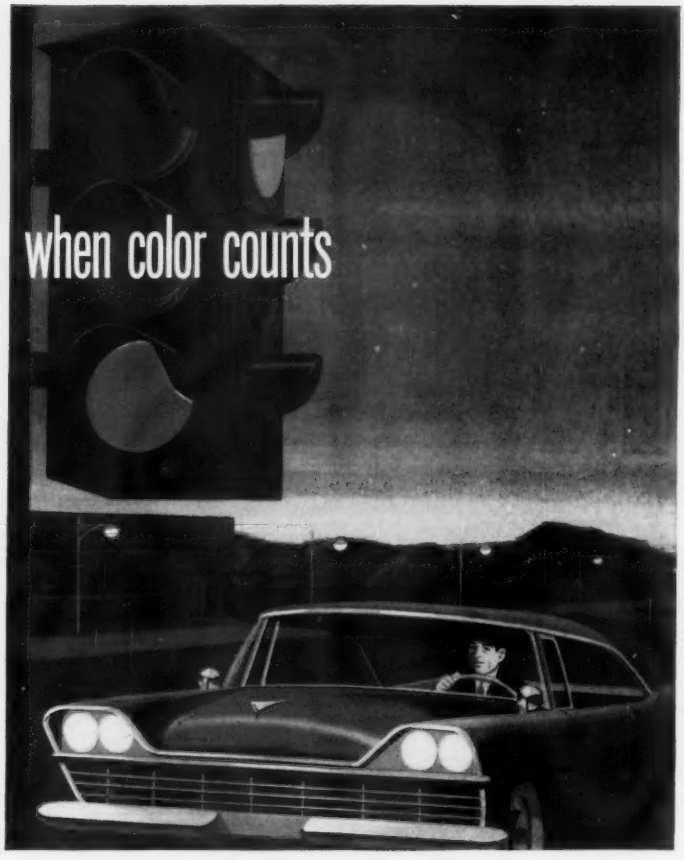
Piccolyte



The light color of **Piccolyte Resin**, coupled with its unusual chemical properties, justifies use in critical compounding. Piccolyte's excellent resistance to oxidation is of special value in this wide field of application.

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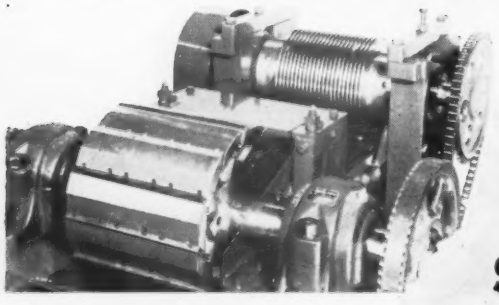
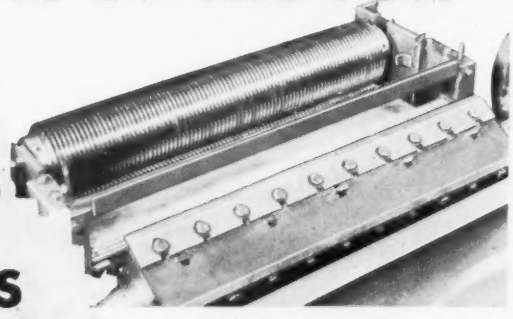
TAYLOR-STILES DICERS CUT UNIFORM PELLETS BY THE TON



from **RODS** *or* **SHEETS**



Producers of pellets from sheets or extruded rods find that Taylor-Stiles machines, engineered to their specific requirements, give them an end product in the exact form they need.

The 700 Series, shown at the left, in widths from 6 to 14 inches, is available with or without circular knives. With circular knives it cuts rubber or plastic sheet stock into strips and then cross cuts it into pellets. Without circular knives it cuts extruded rods directly into pellets.

Models are available with 12 or 24 knives, length of cut up to 3/4", speeds to 2400 rpm.

The machine shown at the right is Taylor-Stiles Series 200, made in widths from 18 to 42 inches, with or without circular knives. The machine illustrated takes 42" wide sheet and then slits and cross cuts it into 1/2" squares. The length of cross cut on 200 Series machines may be almost any dimension from 1/64", or even less, to 10" or 12" or even more.

Many of America's largest producers of rubber and plastic stock are turning to these Taylor-Stiles Dicing Cutters because they make less dust and feathers, require less power to operate and the knives stay sharper longer . . . all this while producing pellets of remarkably exact size.

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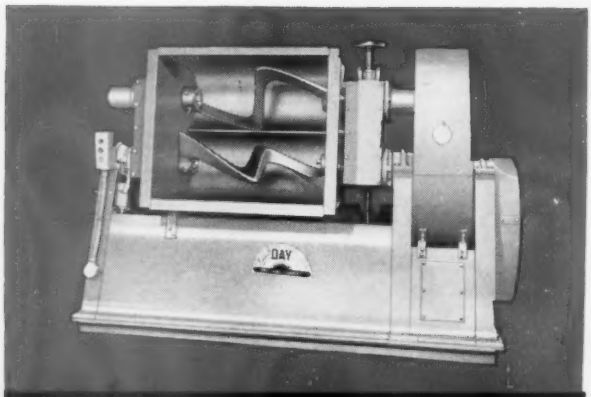
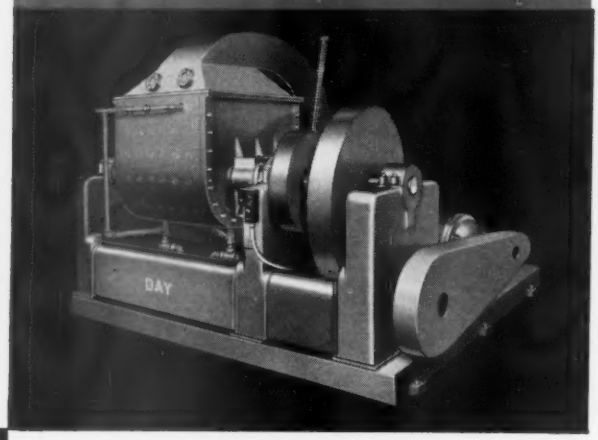


DAY MOGUL



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SERVING THE PROCESS INDUSTRY SINCE 1887

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Shop Talk.....

► Some years ago there was an orchestra leader, quite popular on radio, who composed a number which had no ending. As the score reached an obvious climax, the audience would applaud, whereupon the orchestra would take off once again. After a while, the audience would be reduced to helpless laughter.

The idea of a song without an ending came to us the other day as we read a letter from a subscriber who questioned something which appeared in RUBBER AGE some thirty years ago. It is more than a little sobering to realize that unlike many other professions, that which the editor does today has more than passing significance many years hence.

There used to be a little rhyme that went around the college journalism classes which said that if a doctor made a mistake, he buried it . . . if a lawyer made a mistake, he retried the case . . . but if the editor made a mistake the whole world knew about it.

Well, we answered the thirty-year old inquiry put to us as we attempt to answer all questions put to us each day. The responsibilities of the editors of RUBBER AGE do not end with the publication of each issue . . . we cannot start out fresh each month . . . we must live with and stand in back of each printed word. Our obligations go a step further. As representatives of the rubber industry, we must do our best to offer advice and assistance to all who ask.

When the thought first came to us to relate what the editors of modern trade publications do, we decided to keep some informal records on the visitors who called, the phone calls we answered, the correspondence we received in a given day. First we received a visit from a dental surgeon who used rubber bands in his business of straightening teeth. It seems that the rubber bands which he had been using deteriorated when in contact with saliva, they broke too easily, etc., etc. We thought about his problem for a time, did some checking, and were able to suggest several rubber manufacturers who might be able to help him.

Later, there was a call from a college student who wanted some statistics as to the average yield from an acre of rubber trees for a college paper of some sort. This information was passed on. The telephone call was followed by a visit from a foreign trade delegation who was in this country on a tour of synthetic rubber facilities. Spent a pleasant few hours with these gentlemen suggesting points of interest. During all this time, friend secretary was answering routine requests for reprints, tear sheets, etc.

What we have recounted here are some of the editor's activities during the typical day. Down the corridor the advertising manager spent a good part of his day closeted with a client from a smaller company — one not employing

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Low melting point of MICROFLAKE, plus its very small thin flake size assures rapid and complete dispersion during mixing. It has no effect on the rate of cure.

MICROFLAKE is recommended for passenger car, truck, and tractor tires, channel rubbers, weatherstrips, boots, gas tank filler, neck grommets, insulated wire and cable, hose, belting, footwear, clothing, druggist sundries, and sponge rubber products such as door and trunk sealers.

A test sample incorporated in any of your compounds will convince you of MICROFLAKE's outstanding protective qualities. Write us today. . . . No Obligation, of course.

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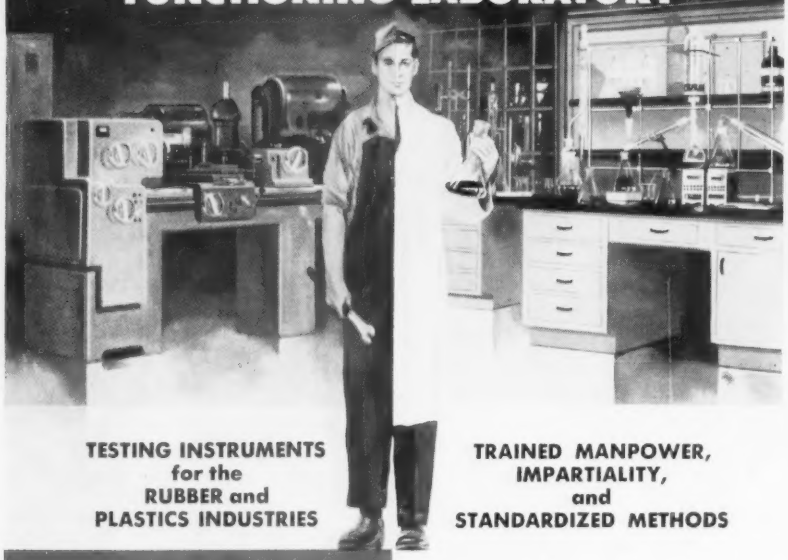
MADE BY A
FUNCTIONING LABORATORY



TESTING INSTRUMENTS for the RUBBER and PLASTICS INDUSTRIES

TRAINED MANPOWER, IMPARTIALITY, and STANDARDIZED METHODS

We Make Them More Efficient Because We Use Them, Too!

As the only functioning laboratory manufacturing instruments, we harness the talents of the laboratory and the instrument technicians. Result: the instruments are conventional in operation, simple to calibrate, easy to maintain. They are sensitive, stable, and, in most cases, applicable to multi-purpose testing requirements. And all are pre-tested in our own laboratories.

Our instrument service is four-fold: we design and manufacture new instruments; we modify existing instruments to meet special needs; we manufacture instruments from existing designs; we operate new instruments where impartial laboratory reports are essential. Write for our free [illegible]

Carson-Worthington Stiffness Tester for pliable sheet forms

Universal Pendulum Impact Tester

Three Vital Contributions of the Independent Laboratory to RUBBER and PLASTICS TESTING

In so fluid and expanding a field as Rubber and Plastics, the problem of testing and research remains acute for the individual manufacturing concern.

The United States Testing Co., with its comprehensive laboratory facilities, offers such concerns important technological services in such timely aspects as:

1. Release of your valuable technical manpower to more creative efforts in more fruitful fields by assumption of the burden of your time-consuming projects.

2. Application of standardized methods to Rubber and Plastics tests for more valid comparisons of material properties, manufacturing processes, and end-use performance.

3. Impartial findings in all phases of Rubber and Plastics testing, offering both an invaluable objective viewpoint and a check against your own test results.

UNITED STATES TESTING COMPANY, INC.

Established 1880

1670 Park Avenue, Hoboken, New Jersey

Boston • Brownsville • Dallas • Denver • Los Angeles • Memphis • New York
Philadelphia • Providence • San Angelo

an advertising agency. This small client wanted some advice on how to advertise to the rubber industry. He wanted to know about markets and how his advertisement should look and why does advertising cost what it does and so on. This was almost an all-day session.

Back in the production department, the production manager spent his day making up an advertisement for another small advertiser. He used his years of experience in the art world to dress up —to make more attractive an eighth-page advertisement. He spent quite a few hours on this eighth page — an eighth page out of about 200 in the issue.

And where did the boss spend his day? The boss was out on the road visiting with a rubber group, discovering the problems, meeting the people, seeing what there was to see. From his excursion will come impressions, facts, news, all of which will one day make their appearance in RUBBER AGE in one way or another.

What does it all mean, what does it add up to? RUBBER AGE is more than just a monthly publication. RUBBER AGE means service—the service we can perform for our readers and for the rubber industry as a whole. The publication of our journal each month is just the one-eighth of the iceberg that shows above the surface.

It may be that you have been stuck with a problem recently. Next time around, try RUBBER AGE—we'd like to help. It may be that you need some technical books but don't know what is available and what will suit your purposes. Try us, we will help. Need some out-of-the-way statistic, some fact? We have all manner of assorted facts and figures—try us. Need a pamphlet on rubber for your school age son and daughter? Ask us, we will send one along. Want a copy of an article that appeared last month, last year, thirty years ago? We will be happy to oblige. Want to know who makes ping pong paddle facing? Coin Mats? Swim fins? We can send you a list.

Surely our motives are not purely altruistic. We sell RUBBER AGE in a competitive market. What we do and how we do it goes to make our product the most attractive and the most serviceable you can get for your money. If there is some way we can serve you—try us. Remember that

means service.

Memo from the Editor

The "Letters to the Editor" columns are open to all of our readers and we invite comments on any pertinent subject for publication. Address: Editor, RUBBER AGE, 101 West 31st St., New York 1, N. Y.

RUBBER CHEMICALS

made by **witco** are made **right** for the **rubber industry**

Get the full benefits of satisfactory performance *every* time with processing chemicals "tailor-made" by Witco for the rubber industry. Highest manufacturing standards insure uniform quality in Witco chemicals...guarantee good compounding results. And top technical service laboratories are freely on call whenever you want help with your processing or formulation problems.

You can't buy better than Witco.

STEARATES
...all types, in grades specially prepared for rubber applications.

M.R. (HARD HYDROCARBON)
...economical extending plasticizer. Other rubber plasticizers and petroleum softeners are also available.

WITCARBS®
...ultrafine precipitated Calcium Carbonates for white rubbers.

SUNOLITE®
...non-staining, anti-sunchecking wax that inhibits atmospheric and corona cracking.

STEARITE®
...stearic acid for dispersing agent, plasticizer and accelerator-activity.

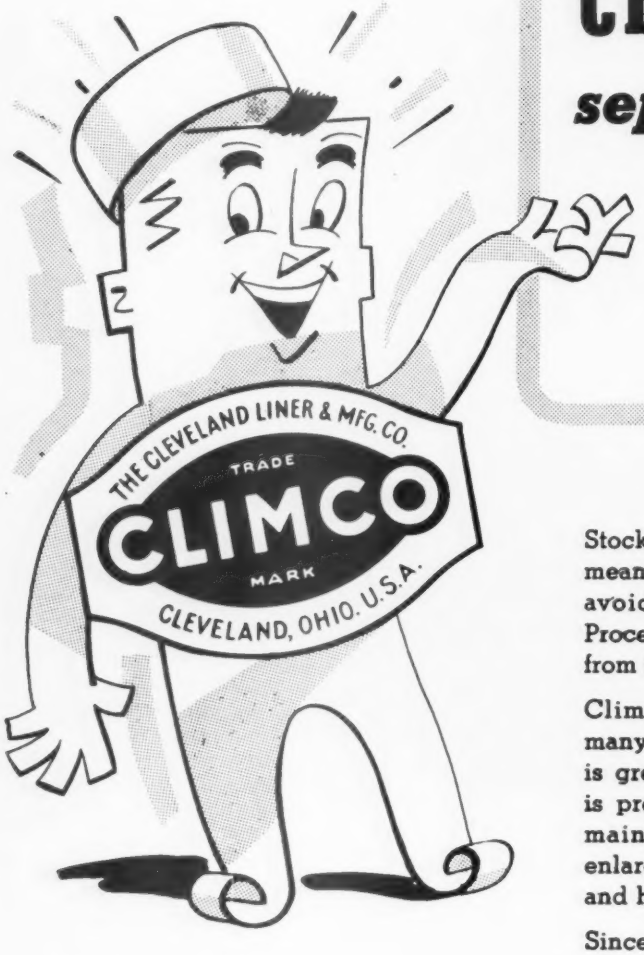
FOMREZ® No. 50
...outstanding polyester for urethane foams.

CARBON BLACKS
...every type and grade for natural and synthetic rubber; from Witco's affiliate, Continental Carbon Company.

WITCO CHEMICAL COMPANY
122 East 42nd Street, New York 17, N. Y.

Chicago • Boston • Akron • Atlanta • Houston • Los Angeles • San Francisco • London and Manchester, England

MR. CLIMCO SAYS . . . . . .



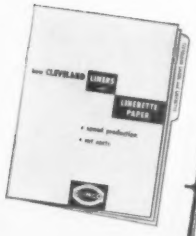
"CLIMCO LINERS *separate perfectly from the stock"*

Stock adhesions at any point in production mean time lost and extra expense. You can avoid such headaches by using Climco Processed liners that can be readily peeled from the stock without sticking.

Climco Processing of your liners assures many other profitable advantages: Liner life is greatly increased, tackiness of the stock is preserved, and gauges are more easily maintained. Latitude in compounding is enlarged, lint and ravelings are eliminated and horizontal storage is facilitated.

Since 1922 Climco Processed Liners have proved their worth to the rubber industry. Give them a trial in your plant.

THE CLEVELAND LINER & MFG. CO.
5508 Maurice Ave. • Cleveland 27, Ohio, U.S.A.
Cable Address: "BLUELINER"



ILLUSTRATED LINER BOOKLET

Tells all about Climco Liners and Linerette and how to get better service from liners. Write for your copy now.

LINERETTE INTERLEAVING PAPER
Treatment Contains
NO OIL OR WAX
Samples on Request

CLIMCO
PROCESSED LINERS
Serving the Industry Since 1921

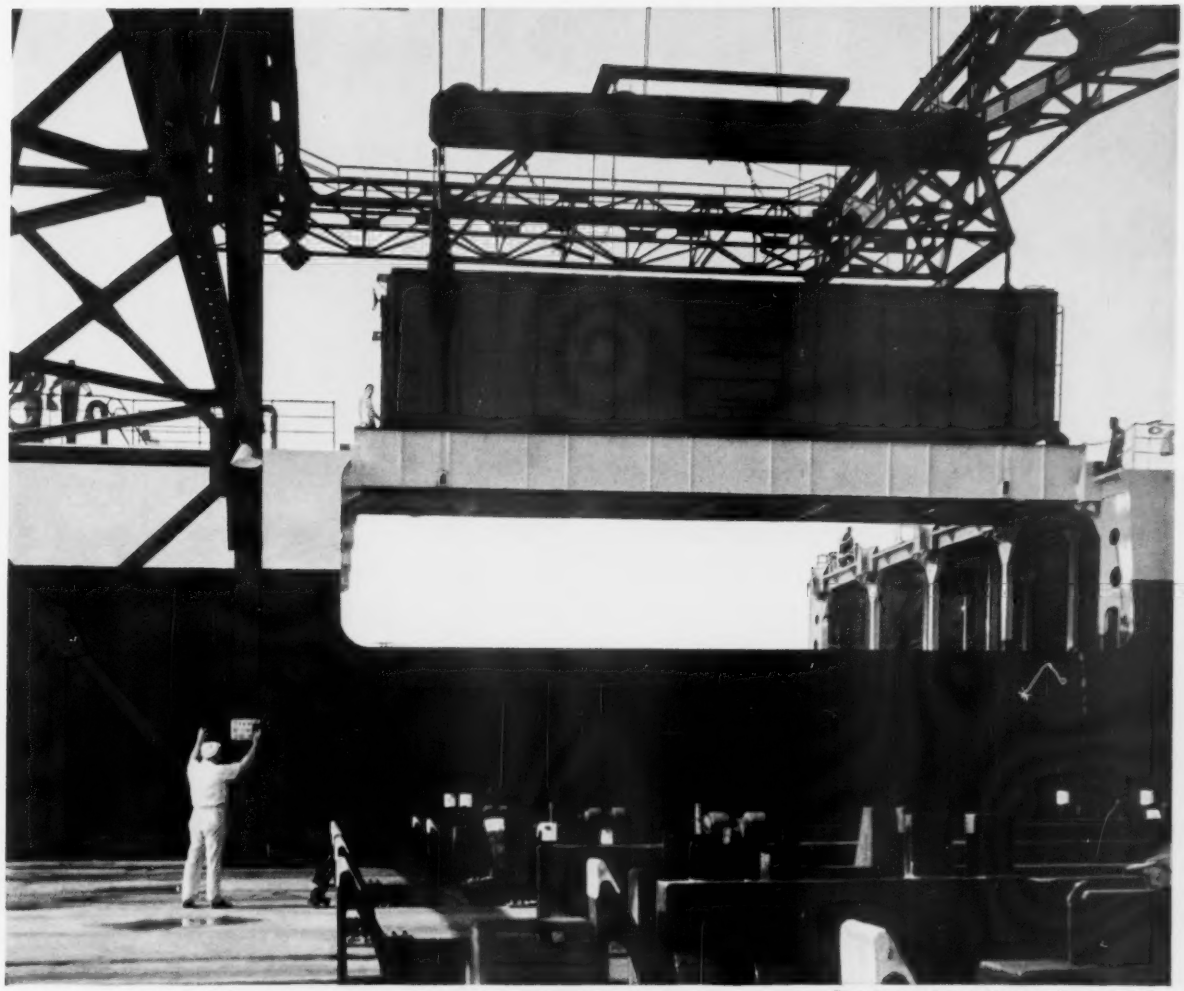


Photo Courtesy Seatrain Lines Inc., New York, N. Y.

What's in this Seagoing Boxcar for You?

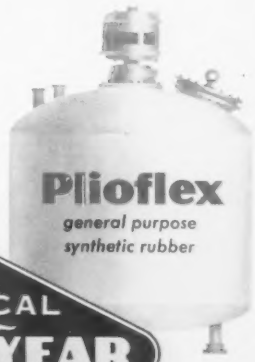
Here's a new way Goodyear can deliver the goods—the better to serve the many users of PLIOFLEX rubber. One of the most unique of all shipping methods—the part-way-by-sea "piggy-backing" of boxcars on a "seatrain vessel" proved a big help to many a Goodyear customer.

Curbing the costly holdups that occur during ordinary ship-loading and unloading, this sea-and-land shipping saves both time and headaches. Up to 100 boxcars travel on one ship. And many of them are factory-loaded with PLIOFLEX on special pallets—opening the door to far-quicker and easier handling in the user's plant.

That's only one example, of course, of the many ways Goodyear constantly works to better service. The pallets are timesavers—carry PLIOFLEX bales in convenient, multiple units. In addition to this new and unique service, strategically located warehouses can fill especially urgent orders —fast. And every customer can obtain all the technical help he needs to get the most out of his PLIOFLEX.

You can be among the many cashing in on this Goodyear brand of service—every time you use PLIOFLEX, the finest of all synthetic rubbers. For its complete story, write Goodyear, Chemical Division, Department O-9419, Akron 16, Ohio.

Chemigum, Plioflex, Pliolite, Pliovic—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



CHEMICAL
GOODYEAR
DIVISION

RUBBER &
RUBBER CHEMICALS
DEPARTMENT

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

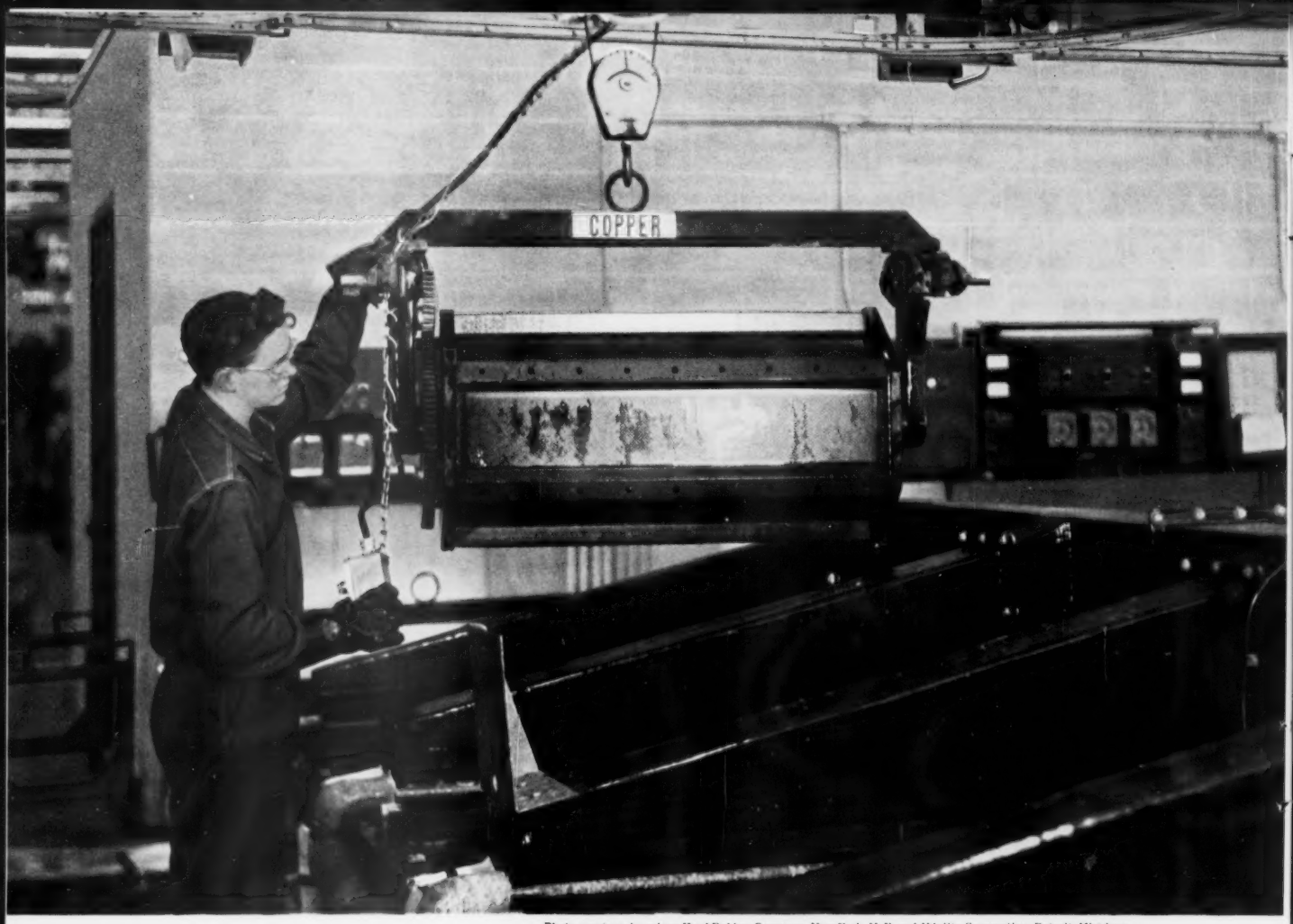


Photo courtesy American Hard Rubber Company, New York, N. Y. and Udylite Corporation, Detroit, Michigan

New Answer to a Barrel of Hot Problems

Hot problem for a leading supplier of electroplating barrels was finding the right material for the cylinders. In the face of repeated exposure to heat, hard wear and corrosive plating solutions, these cylinders had to keep rolling without contaminating the baths. After many tries, they found the answer—a new, clean-running hard rubber with three times longer life.

The major advance of this new material over its predecessors springs from the fact that it's made with CHEMIGUM nitrile rubber. Its manufacturer uses CHEMIGUM for a combination of strength plus resistance to high temperatures, chemicals and solvents never before achieved in hard rubber.

Besides better barrels for plating, CHEMIGUM as hard rubber has wide applications as pipe fittings and other equipment for handling chemicals at high temperatures. In other forms, CHEMIGUM finds use in many other products requiring unusual resistance to oils, solvents and chemicals over a wide range of temperatures.

If you have a need for an unusually versatile oil-resistant rubber of high quality, be sure you have the full story on CHEMIGUM. It's easy to get. Just write to: Goodyear, Chemical Division, Dept. O-9419, Akron 16, Ohio.

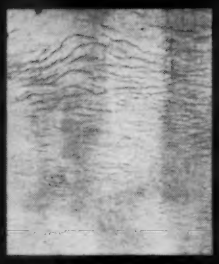
CHEMICAL
GOODYEAR
DIVISION

RUBBER &
RUBBER CHEMICALS
DEPARTMENT

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

	ANTIOXIDANT "A"	ANTIOXIDANT "B"	WING-STAY T
SUNLIGHT AGING TEST (Styrene rubber)			
WINDOW AGING TEST (Styrene rubber) **Time to first crack, in weeks**	4	6	12
OXYGEN BOMB TEST (Extracted pale crepe gum stock–18 days @ 50° C. and 150 psi) **% Tensile retained**	0.0	26.7	81.4
% Weight increase	17.55	1.43	0.38
CREEP TEST (Styrene rubber gum vulcanizates – open tube @ 110° C.) **Hours to 20% creep**	10	17	28

A case of more than meets the eye

The samples pictured above tell the more obvious part of the story: There's no beating new WING-STAY T when it comes to resisting discoloration under sunlight aging.

But there's even bigger news in the data under the samples. They clearly show the superior antioxidant activity–the greater protection for the rubber–offered by WING-STAY T as compared to other nonstaining antioxidants.

You'll find it worth your while to try WING-STAY T for the protection of compounded natural, styrene/butadiene or nitrile rubbers in any of the usual light-colored applications. You'll also find this nonhydrolyzable liquid well suited to the protection of raw polymers.

Full details, including the latest *Tech Book Bulletins*, on WING-STAY T are yours for the asking. And that's just part of the outstanding service you'll get on this and other products in one of the most complete lines of raw materials for the rubber industry. Just write to: Goodyear, Chemical Div., Dept. O-9419, Akron 16, Ohio.

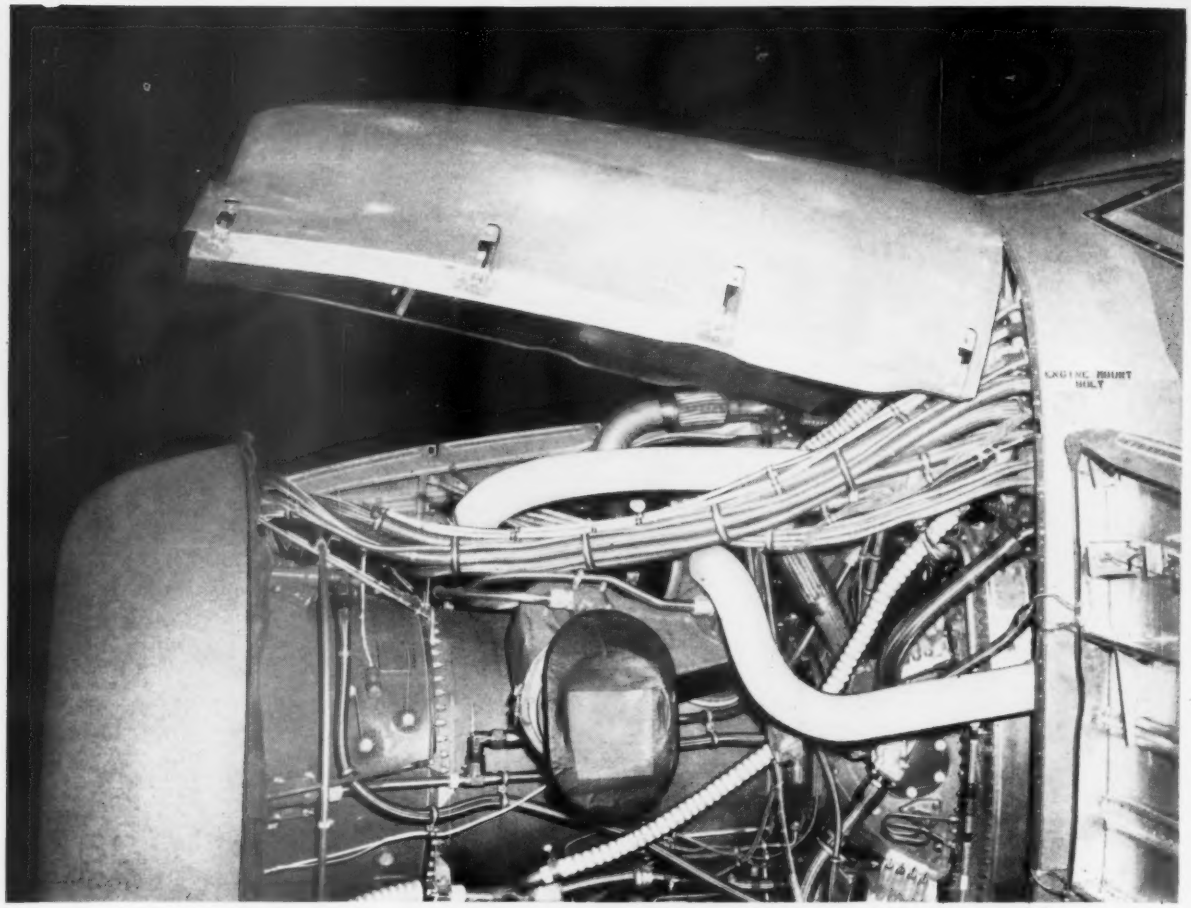
GOODYEAR

60th GOODYEAR ANNIVERSARY

CHEMICAL DIVISION

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIOVIC • WING-CHEMICALS

Chemigum, Pliolex, Pliolite, Pliovic, Wing-Stay–T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



SILASTIC 432 Base

Makes Hose Serviceable From –100 to +500F

TYPICAL PROPERTIES OF HOSE, DUCTS AND TUBING COMPOUND MADE WITH SILASTIC 432 BASE

	Cured 24 hrs at 480 F		Aged 24 hrs at 600 F
Temperature range, degrees F	—100	to	+500
Specific Gravity			1.27
Hardness, durometer	55		60
Tensile Strength, psi	850		770
Elongation, %	250		200
Compression Set, percent, 22 hrs at 300 F	20		18

Properties obtained on ⅛" ASTM slabs or buttons, molded 5 minutes at 240 F.

The compounding of stocks with superior physical properties for hose, ducts and tubing is easier with Silastic* 432 Base. This partially-compounded silicone rubber gum requires no bin aging after compounding, is easy to calender onto glass, dacron or nylon and can be dispersed in solvents for spread, dip or flow-type coatings. All compounds made from Silastic 432 Base retain remarkable resistance to extreme temperatures and abrasion. They have high tensile strength, good elongation and low compression set.

Do you want the recipe? *Complete instructions for compounding Silastic 432 Base for hose, duct and tubing compound is yours for the asking at the nearest Dow Corning branch office.*

FREE SAMPLE... *Try Silastic 432 Base in your own plant. Write today. Address Dept. 923.*

A team of compounding and fabricating experts is available for visits to your plant. If you would like this team to work with your group, contact your Dow Corning representative.

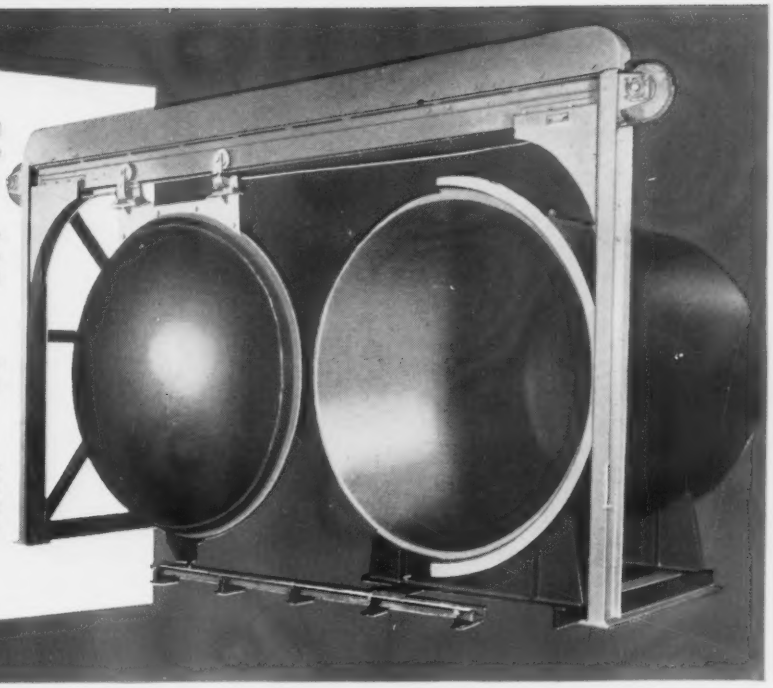
first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C.
CANADA: DOW CORNING SILICONES LTD., TORONTO GREAT BRITAIN: MIDLAND SILICONES LTD., LONDON FRANCE: ST. GOBAIN, PARIS

*T. M. REG. U. S. PAT. OFF.

- a variety of door opening and closing methods—many suitable for automatic-cycle operation
- vulcanizers can be built for either horizontal or vertical operation—with hydraulic rams for mold compression
- most vessels can be fitted with internal circulating fans, driven by externally mounted motors
- designs and patterns are available for full vacuum or internal pressures up to 2500 psi, in most diameters up to 15 ft. and any length



ADAMSON UNITED

offers Vulcanizers and Autoclaves to meet every industrial need

Adamson United has designs and patterns for a full line of vulcanizers and autoclaves—units now serving a variety of industries in the United States and abroad. We'll be pleased to furnish more detailed information and quotations on standard units. Or, Adamson United engineers, backed by 63 years of experience in the design and construction of pressure vessels, will be glad to work with you to develop special units to meet your special needs. Our staff of field service technicians is also ready to serve you.

Products for the rubber, plastics and plywood industries by ADAMSON UNITED

rolls • calenders • mixers • washers • crackers • pot heaters • ram type vulcanizers • autoclaves hydraulic presses • platen presses • steam platens • accumulators • automatic curing presses • belt curing presses • belt stretchers • auxiliary equipment • mills • refiners • plywood presses • compression molding presses • brake and tire testing machines • laboratory equipment • embossing calenders • Rotocure machines

Adamson United Company

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SALES OFFICES IN PRINCIPAL CITIES

Subsidiary of United Engineering and Foundry Company

Plants at PITTSBURGH • VANDERGRIFT • YOUNGSTOWN • CANTON • WILMINGTON (Lobdell United Division)

SPECIAL HEAVY MACHINERY and EQUIPMENT FOR COMPLETE PROCESSES

RUBBER AGE

the rubber field's foremost publication

The Responsibility of Leadership

A leader is, among several other things, that one individual or organization showing a **willingness** to give just a little more than the rest.

RUBBER AGE, with an already impressive list of editorial "firsts" to its credit, announces another of major importance to readers and advertisers alike!

Mills Shepard, Inc., has been retained to conduct readership studies of RUBBER AGE during 1958.

Mills Shepard, Inc., uses a continuing, rapid means of reader identification and evaluation to study and gauge editorial and advertising effectiveness. Initially, four 1958 issues of RUBBER AGE will be studied:

JANUARY APRIL JULY OCTOBER

The results of these studies, supplementing our own program of editorial research and evaluation, will be used by our editors as significant tools in maintaining the editorial superiority that readers have come to expect from RUBBER AGE.

Thus, RUBBER AGE once again displays its willingness to accept the responsibilities of leadership.

RUBBER AGE

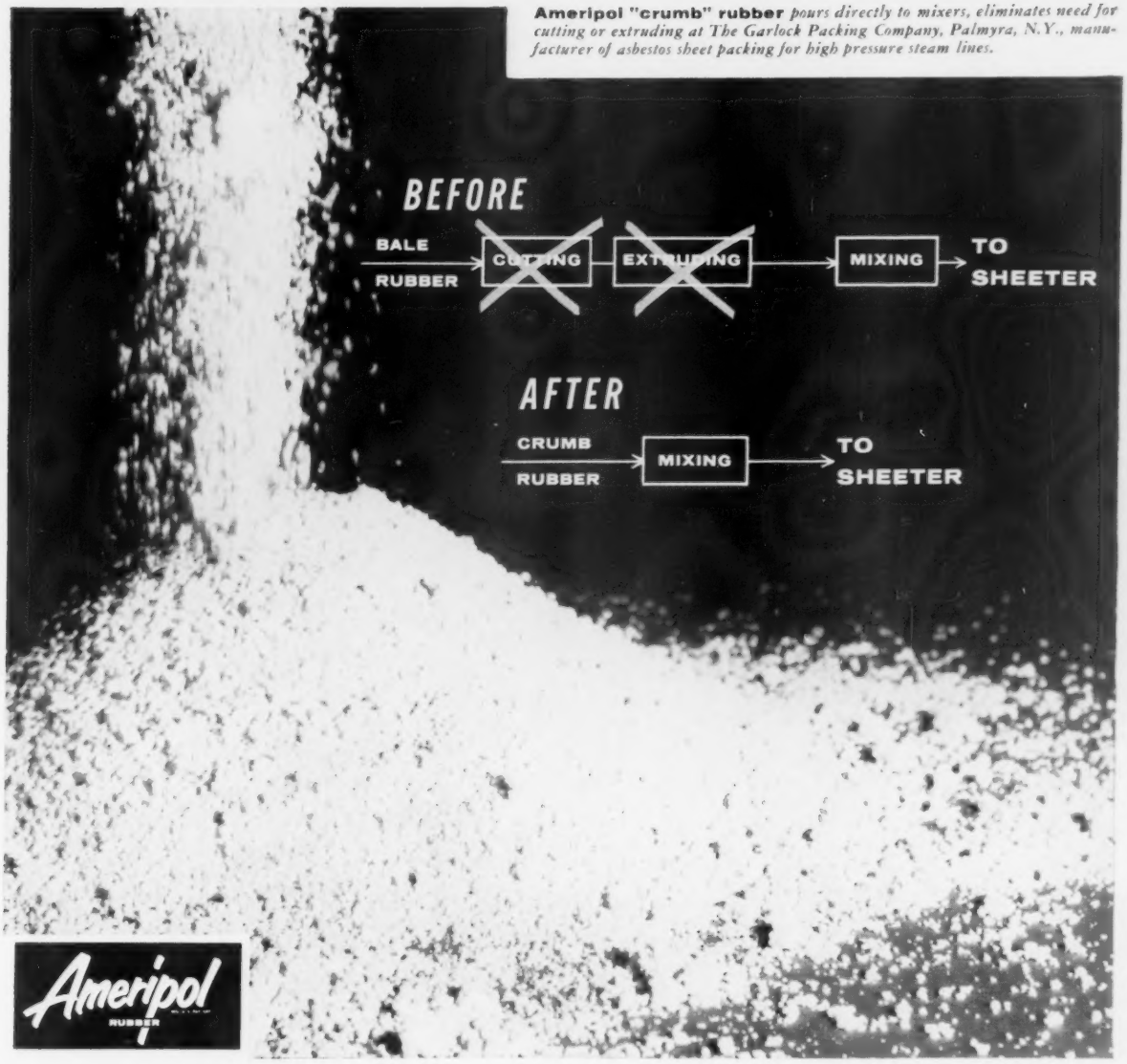
101 West 31st St.
New York 1, N. Y.

ABP ABC

RUBBER AGE

FIRST IN: EDITORIAL VOLUME • ADVERTISING VOLUME • PAID CIRCULATION • EXCLUSIVE ADVERTISERS • FIELD'S ONLY ABC PAPER

Also Publishers of the Industry's only Directory
RUBBER RED BOOK



Ameripol "crumb" rubber *pours directly to mixers, eliminates need for cutting or extruding at The Garlock Packing Company, Palmyra, N.Y., manufacturer of asbestos sheet packing for high pressure steam lines.*

eliminates two processing steps; cuts mixing time in half!

Processing costs really tumbled when The Garlock Packing Company switched to Ameripol "crumb" polymers as the adhesive filler for asbestos sheet packing. New "crumb" Ameripol goes right into the mixer with no prior processing. Formerly, it was necessary to cut and extrude rubber to convert it to spaghetti-like form before mixing.

The rubber is dissolved in a solvent to mix with asbestos and produce a uniform mixture before sheeting. "Crumb" Ameripol with its small particle size and extra porosity soaks up solvent faster. Mixing time is cut from 3 hours to 1½.

This new form of butadiene-styrene rubber was developed by Goodrich-Gulf research for just such savings in processing and equipment. "Crumb" form hot polymers are available in production quantities to cut your processing costs, too.

Call us for your requirements

Goodrich-Gulf Chemicals, Inc.

3121 Euclid Avenue • Cleveland 15, Ohio

THE NAME TO REMEMBER FOR QUALITY BACKED BY YEARS OF RESEARCH AND EXPERIENCE

Rubber latex fresh from the tree is poured through strainer into large tank where acid will be added to coagulate it to solid rubber on Malayan plantation.

Loading ore cars in one of the St. Joseph Lead Company's zinc mines in upper New York State.

The beginning of

the END-PRODUCT

One of the many marvels of chemical engineering is graphically exemplified in these photos. The product of a tree in far off Malaya and that of a zinc mine in New York State, namely rubber latex and zinc oxide—together with several other ingredients—will eventually be united in multiple marriage. The resulting "issue" are the countless rubber products essential to the nation's economy.

Zinc Oxide is a basic ingredient in nearly all products made from either natural or synthetic rubber compounds. **ST. JOE lead-free ZINC OXIDES** are produced by a unique electrothermic method—a modification of the direct-from-ore, or American Process. Zinc Oxides thus produced combine most of the desirable properties of the American and French Process types.

ST. JOE ZINC OXIDES are available in grades to fit most any need, and their uniform high quality accounts for their wide use by the country's leading producers of rubber products.

ST. JOSEPH LEAD COMPANY

250 PARK AVENUE
NEW YORK CITY 17

Plant & Laboratory: Monaca (Josephtown) Pa.

for new equipment, spares or replacements . . .

UNITED *Service-Proved* CRACKER ROLLS

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service-proved
ROLL

When you specify UNITED ROLLS, your complete satisfaction is guaranteed by over 50 years' experience in the design and manufacture of rolls for practically every type of rolling application. Precision engineered to the specific requirement of the individual machine or equipment in which they are to be used, UNITED *Service-Proved* ROLLS are in use the world over by processors of rubber, plastics, linoleum, paper, paint and scores of other metallic and non-metallic substances.

Specify UNITED ROLLS for new equipment, spares or replacements. The experience and advice of our rolls engineers is available without obligation.

FOR EVERY
- **RUBBER**
- **PLASTICS**
- **LINOLEUM**
- **TILE**
- **PAINT**
- **OR OTHER**

NON-METALLIC *PROCESSING REQUIREMENT*

UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown
Canton • Wilmington

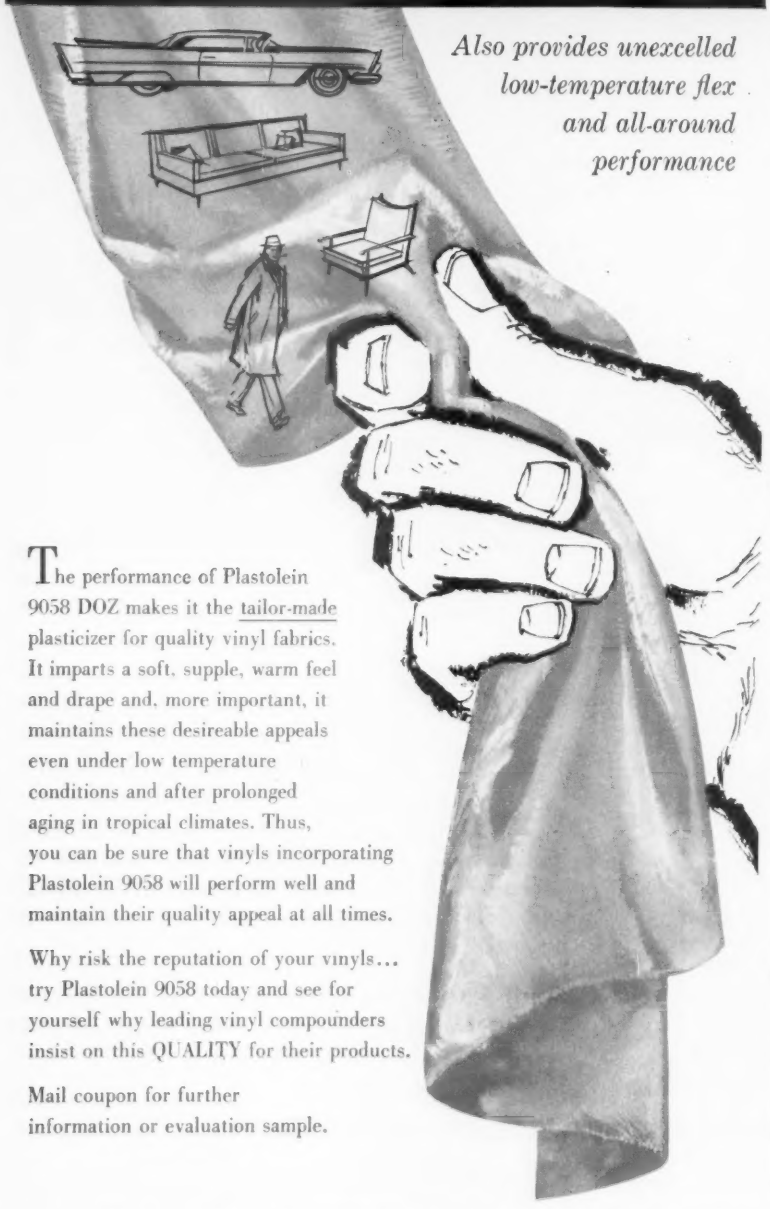
SUBSIDIARIES: Adamson United Company, Akron, Ohio
Stedman Foundry and Machine
Company, Inc., Aurora, Indiana

Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

The Superior Drape and "Hand" imparted by

PLASTOLEIN 9058 DOZ

stamps "QUALITY" on vinyl fabrics!



Also provides unexcelled low-temperature flex and all-around performance

The performance of Plastolein 9058 DOZ makes it the tailor-made plasticizer for quality vinyl fabrics. It imparts a soft, supple, warm feel and drape and, more important, it maintains these desireable appeals even under low temperature conditions and after prolonged aging in tropical climates. Thus, you can be sure that vinyls incorporating Plastolein 9058 will perform well and maintain their quality appeal at all times.

Why risk the reputation of your vinyls... try Plastolein 9058 today and see for yourself why leading vinyl compounders insist on this QUALITY for their products.

Mail coupon for further information or evaluation sample.

Organic Chemical Sales Department

Emery

Emery Industries, Inc.
Carew Tower, Cincinnati 2, Ohio

Emery Industries, Inc.
Dept. U-3, Carew Tower
Cincinnati 2, Ohio

- ☐ Send me bulletin on Plastolein Plasticizers
- ☐ Send me 1 pint sample of Plastolein 9058 DOZ
- ☐ Send a technical representative

Clip this coupon to your letterhead, sign name and title, and mail today.

COMING

Mar. 21. Boston Rubber Group, Spring Meeting, Somerset Hotel, Boston, Mass.

Mar. 28. New York Rubber Group, Spring Meeting, Henry Hudson Hotel, New York, N. Y.

April 10. Fort Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

April 11. Akron Rubber Group, Spring Meeting, Sheraton-Mayflower Hotel, Akron, Ohio.

April 16. Washington Rubber Group.

April 17. Quebec Rubber and Plastics Group.

April 18. Detroit Rubber & Plastics Group, Spring Meeting, Detroit-Leland Hotel, Detroit, Mich.

April 25. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

May 9. Buffalo Rubber Group, General Brock Hotel, Niagara Falls, Ont., Canada

May 14-16. Division of Rubber Chemistry, A.C.S., Spring Meeting, Netherlands Plaza Hotel, Cincinnati, Ohio.

May 21. Washington Rubber Group.

May 23. Connecticut Rubber Group.

June 5. New York Rubber Group, Summer Outing, Doerr's Grove, Milburn, N. J.

June 20. Akron Rubber Group, Summer Outing, Firestone Country Club, Akron, Ohio.

June 22-28. A.S.T.M. Annual Meeting, Hotel Statler, Boston, Mass.

June 27. Detroit Rubber & Plastics Group, Summer Outing, Western Golf and Country Club, Detroit, Mich.

July 25. Chicago Rubber Group, Golf Outing, Medinah Country Club, Medinah, Ill.

Aug. 5. New York Rubber Group, Golf Outing, Wingfoot Golf Club, Mamaroneck, N. Y.

Sept. 6. Connecticut Rubber Group, Summer Outing.

EVENTS

Sept. 10-12. Division of Rubber Chemistry, A.C.S., Fall Meeting, Hotel Sherman, Chicago, Ill.

Oct. 3. Detroit Rubber & Plastics Group. Fall Meeting. Detroit-Leland Hotel, Detroit, Mich.

Oct. 17. New York Rubber Group, Fall Meeting, Henry Hudson Hotel, New York, N. Y.

Oct. 24. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

Nov. 14. Connecticut Rubber Group.

Nov. 17-21. Society of the Plastics Industry Annual National Conference, Morrison Hotel, Chicago, Ill.

Nov. 30-Dec. 5. A.S.M.E. Annual Meeting, Hotel Statler, New York, N. Y.

Dec. 12. Detroit Rubber & Plastics Group. Xmas Party. Sheraton-Cadillac Hotel. Detroit, Mich.

Dec. 12. New York Rubber Group, Xmas Party.

May 12-15, 1959. Division of Rubber Chemistry, A.C.S., Spring Meeting. Biltmore Hotel, Los Angeles, Calif.

Nov. 9-13, 1959. Joint International Meeting of Division of Rubber Chemistry, A.C.S.; Committee D-11, A.S.T.M., and Rubber and Plastics Division, A.S.M.E., Shoreham Hotel, Washington, D. C.

May 24-27, 1960. Division of Rubber Chemistry, A.C.S., Spring Meeting, Hotel Statler, Buffalo, N. Y.

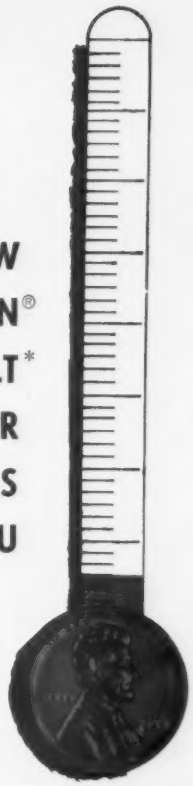
Sept. 13-16, 1960. Division of Rubber Chemistry, A.C.S., Fall Meeting, Commodore Hotel, New York, N. Y.

May 16-19, 1961. Division of Rubber Chemistry, A.C.S., Spring Meeting, Brown Hotel, Louisville, Ky.

Sept. 5-8, 1961. Division of Rubber Chemistry, A.C.S., Fall Meeting, Hotel Sherman, Chicago, Ill.

May 15-18, 1962. Division of Rubber Chemistry, A.C.S., Spring Meeting, Hotel Statler, Boston, Mass.

NEW PLASTOLEIN® 9078 LT* PLASTICIZER GIVES YOU



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*Low temperature

Comparison of Plastolein 9078 with di-decyl adipate

	Plastolein 9078	DDA		Plastolein 9078	DDA
Parts Geon 101	100	100			Borderline
Parts Plasticizer	48	49	Masland Impact, ° C	—40	at —40
Tensile, psi	2650	2400	Extraction, mg/in²		
Elongation, %	365	360	Water, 24 hrs. @ 50° C	0.2	0.1
Modulus, 100%, psi	1130	1240	Soapy Water, 24 hrs.		
Hardness, D.10 sec.	85	89	@ 50° C	1.0	0.4
Volatility, SPI, 70° C			Min. Oil, 24 hrs. @		
1 day-mg/in²	1.9	2.3	25° C	11.1	19.8
7 days-mg/in²	8.0	9.1	Compatability, Roll		
			Spew	Slight	Severe

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- ☐ Please send a pint evaluation sample
- ☐ Please send a technical representative

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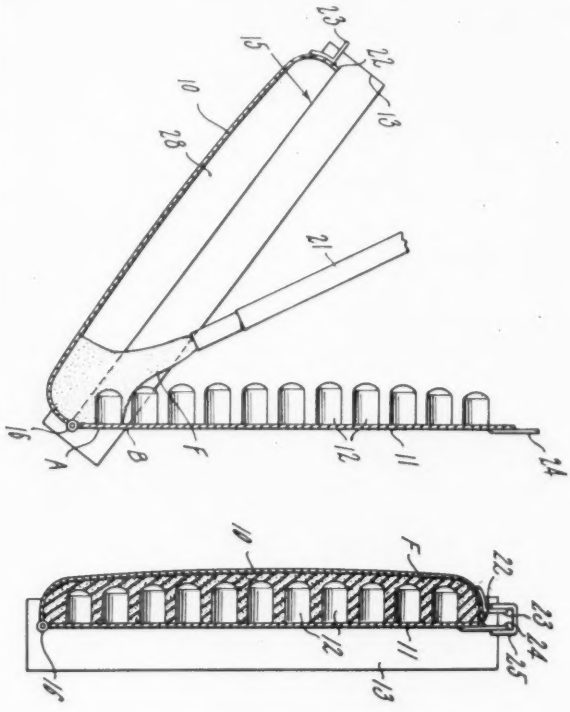
PATENT REVIEW

by Melvin Nord

Method of Making Elastic Cushions

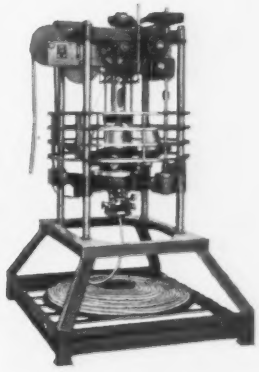
U.S. 2,804,650, issued September 3, 1957 to Joseph W. Kunce and assigned to United States Rubber Co., describes a method of forming elastic cushion articles which eliminates objectionable void spaces.



The illustration shows the mold in open position (top) and closed position (bottom). A latex rubber foam is poured from a hose (21) into the bottom of the mold. As the foam is admitted, the mold cover (11) is swung toward its closed position, so that as the foam rubber rises, the mold is progressively closed. The air in the cavity is thus displaced upward by the foam, and escapes to the atmosphere.

As the mold is progressively closed during filling, sufficient foam will be retained in the lower part of the mold cavity to fill it, and excess foam in the closed trough will be forced upward to fill the still void portions of the cavity until the mold cover is substantially closed on the mold pan. At this point the flow of foam to the mold cavity is interrupted. The cover is then completely closed to force the latex foam which is in that portion of the trough not formed by the mold cavity upward into the remainder of the cavity to fill it, and

New Lock Stitch* Reinforcement for Automotive and Industrial Hose at 1,000 FEET PER HOUR with the FIDELITY Vertical Knitter



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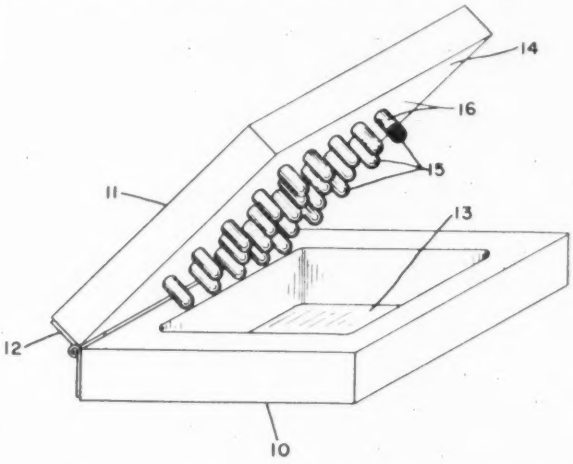
PATENT REVIEW

to extrude a small amount of foam from the mold along the upper end to insure that the mold cavity is completely filled. When the mold is completely closed, the operator may remove this small quantity of extruded foam from the end of the mold by hand and deliver it to a tank containing a desensitizing fluid, and thus reclaim this scrap rubber.

By utilizing the mold and the method of this invention, a foam cushion article can be formed which has no objectionable voids in it. Furthermore, the amount of waste foam is substantially reduced or eliminated.

Cold Method for Molding Rubber Foam

U.S. 2,804,653, issued September 3, 1957 to Anselm Talalay, assigned to Dayton Rubber Co. and B. F. Goodrich Co., relates to the manufacture of foam rubber articles by cooling the foamed aqueous dispersion of elastomeric material below its freezing point.



As shown in the diagram, the mold consists of a lower dish (10) and an upper pin plate (11) connected by a hinge (12). A refrigerant is circulated through the hollow-walled pin plate (11), so that the wall (14) and core pins (15) may be cooled in an open atmosphere before the mold is closed. This cooling should be continued until the surfaces are brought to a temperature below the frost point of the atmosphere to which the pin plate is exposed. If necessary, the surfaces may be sprayed with water to form the desired ice film.

Once the desired ice film has formed, the partially expanded aqueous dispersion of latex, containing the usual compounding ingredients to which have been added say a potassium oleate soap as a stabilizer, and peroxide catalysed with yeast or catalase as a foaming agent, is cast into the cavity within the lower mold member. It has been found desirable to wait until the foamed latex composition has expanded to fill approximately 75 per cent of the mold cavity before closing the mold and immersing the ice coated pins into it. After

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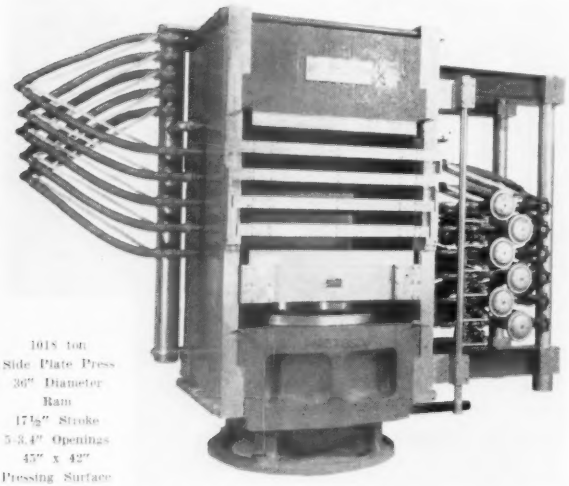

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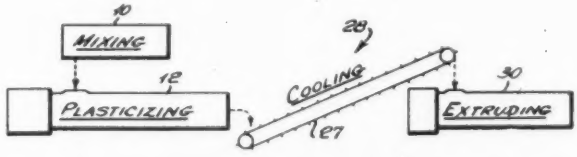
PATENT REVIEW

sufficient time has elapsed for complete filling of the mold cavity, the temperature of the mold dish is brought to —30°C. and held at this temperature for a period long enough to freeze the whole mass of the foam. After this the foam rubber composition is irreversibly coagulated by circulating a fluid coagulant, such as carbon dioxide gas, for a few minutes through the interconnecting interstices of the foamed and frozen rubber.

Method for Reclaiming Rubber

U.S. 2,804,651, issued September 3, 1957 to Chester H. Peterson, assigned to U.S. Rubber Reclaiming Co., Inc., provides a method in which reclaim rubber is extruded at a relatively low temperature and under relatively low pressure after the completion of the reclaiming operation.



As shown in the illustration, vulcanized rubber crumb is mixed with reclaiming agents (10) and then subjected to a plasticizing reclaiming operation by being passed through a screw plasticator (12), where it is reclaimed. An outlet head portion provides a clear, open channel which is free of internal obstructions and from which the reclaim will issue in strip (slab or sheet) foam.

The reclaimed material passes on a conveyor (27) through a zone (28) where it is cooled by the surrounding atmosphere, and then is subjected to an extrusion step by being passed through an extruder (30), from which it issues in a condition to be stored or to be shipped. Temperatures in the extruder run from 175 to 275°F.

The product has a higher tensile strength and 300% modulus, and a higher Mooney than reclaims subjected to the usual refining operations, as well as improved working and handling properties.

Tubeless Tire with Improved Liner

U.S. 2,789,527, issued July 9, 1957 to Robert W. Kindle and John J. Fleming, assigned to United States Rubber Co., discloses a tubeless tire with an air-retaining liner based on a mixture of (a) natural or styrene rubber, (b) a particular kind of reclaimed butyl rubber, and (c) butyl rubber that has been chemically modified by reaction with dinitrosobenzene.

The reclaimed butyl rubber is obtained by reclaiming vulcanized butyl rubber in the presence of reclaiming oil, care being taken to limit the extent of the reclaiming operation so that the reclaim contains a limited amount of low molecular weight rubber hydrocarbon, as determined by the standard chloroform test (10 to

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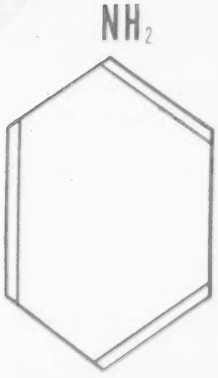

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PATENT REVIEW

22 per cent). The final liner stock contains the above three ingredients, together with carbon black, vulcanizing ingredients, accelerators, and activators. Samples of this liner stock, after curing in a press for 30 minutes at 45 pounds of steam had the following properties: tensile—1040 psi; elongation—613 per cent; 300 per cent modulus—300 psi.

Accelerators for Butyl Rubber

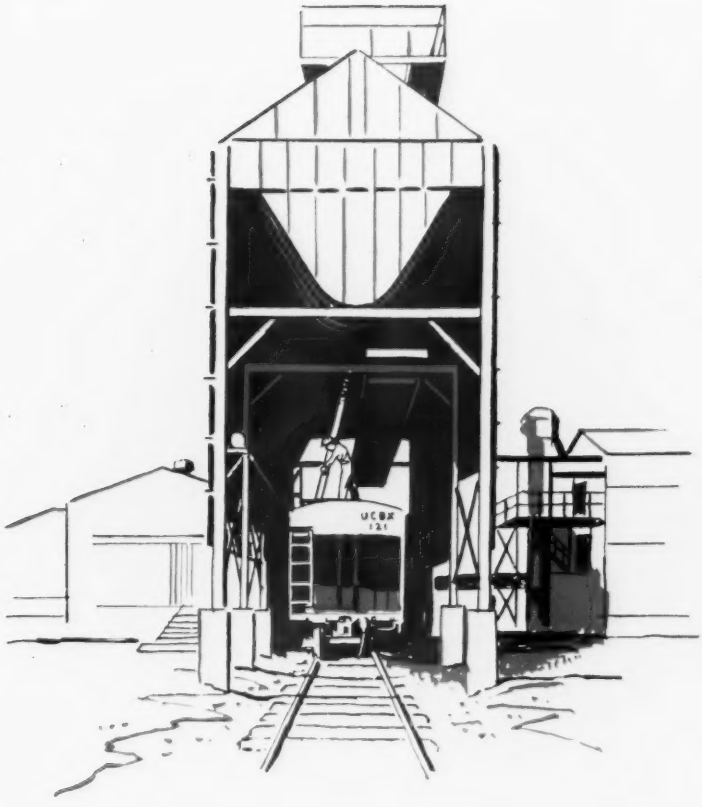
U.S. 2,794,009, issued May 28, 1957 to Paul F. Gunberg and assigned to United States Rubber Co., relates to a process for promoting the reactions of butyl rubber with dimethylol phenols.

It has been found that the vulcanization of butyl rubber with dimethylol phenols is greatly accelerated by the presence of a small amount of an organic sulfonic acid, and excellent cures can be obtained in a considerably shorter time, or at a lower temperature, than would otherwise be possible. Although the cure proceeds rapidly, there is no difficulty from reversion and consequent loss of physical properties if the curing conditions are unduly prolonged or severe. The patent cites several examples of the use of such accelerators as p-toluene sulfonic acid, β-naphthalene sulfonic acid, and mixed alkanesulfonic acids. About 1 to 5 parts of the acid are used per 100 parts of butyl rubber.

Other Patents Of Interest

Subject	Inventor or Assignee	Patent No.	Date
Steam-heated patching means for tire casings	Howard Robb	2,797,438	7/2/57
Foam rubber mold constructions	Dayton Rubber Co.	2,797,442	7/2/57
Tire adapter means	Raymond C. Carroll et al	2,797,722	7/2/57
Tire bead seating device	Fred Smith	2,797,744	7/2/57
Wheel chock	Dayton Rubber Co.	2,797,774	7/2/57
Rubber compositions containing triazine blowing agents	American Cyanamid Co.	2,798,055	7/2/57
Coating compositions containing chlorinated rubber	Hercules Powder Co.	2,798,056	7/2/57
Zinc salt of 2-mercaptobenzothiole as a rubber accelerator	American Cyanamid Co.	2,798,106	7/2/57

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.



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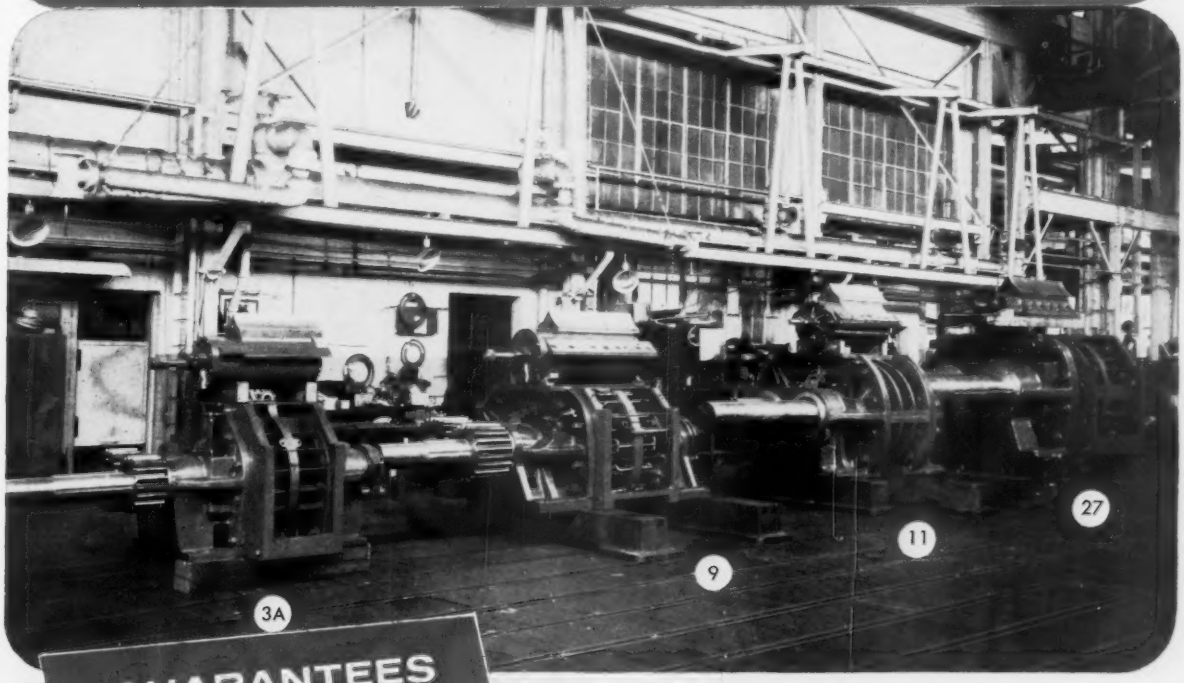

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Capitol Cues

DON'T LOOK FOR A BUSINESS UPTURN BEFORE FALL—that's the dominant belief of top economists in business and government. Sure, they have seen the forecasts of a Spring pick-up made by the President's advisers. But they find these too optimistic. They don't see what powerful lifting force can end the business easing that soon. In the view of the great majority of experienced analysts, "Ike's men are trying to whistle up an upturn."

> Business will continue to ease during the first half. The key economic influence will be the sizable drops in investment by business in new plant and inventory. Lowered auto sales and exports will add to the drag. It will take several months to halt, and then reverse, all this downward momentum.
>
> The increasing rate of defense spending should start making a real difference in the second half. Not only is the President proposing extras, Congress will raise the ante still further. And business will get a real psychological shot-in-the-arm from expectations of still more expansion in defense to come.
>
> Finally, we're heading back into an era of Budget deficits, and those deficits have a way of stimulating consumer buying. All in all, business activity seems likely to level out this Summer, and to start firming up early in the Fall—not before.

EVIDENCE INDICATING THE EASING WILL BE MILD—though not as mild as Eisenhower's advisers say—comes from business-cycle experts who have been studying the record of industry's ups and downs for many years. You can't assume that what's now happening will duplicate any of the 24 cycles of the last 100 years. But the figures let you compute some interesting odds.

> The length of downswings was under 18 months four out of five times in cycles since 1885. Half the slides lasted 18 months or less. So, if the last boom peaked in July 1957, odds are 2 to 1 the present dip will end by August, 4 to 1 by November.
>
> The depth of a decline can't be figured as precisely. But the record seems to show that severe slumps only follow feverish booms. The upswing from mid-'54 to mid-'57 was NOT feverish. The three-year rise measured only 14%, bottom to top.

ARE WE AHEAD OF OR BEHIND THE RUSSIANS in military power? There are so many contradictory answers to this question every day, it's hard for the citizen to know just what is what. To help make sense of it all, we have talked to many of the men in the know. We pushed them hard, off the record. This is the way they size things up:

> At the moment, the U.S. is NOT in bad shape relative to the Reds. They still don't have a multitude of missiles in being. Our Strategic Air Force is still the biggest deterrent to war.
>
> In the future—and not very distant—the Soviets can gain a decisive edge, despite our success in launching a satellite. They are ahead in development work on the new weapons, while our present and prospective programs won't make us catch up.

(Continued on Next Page)

THE BUDGET FOR 1959 IS INADEQUATE—you hear that on almost every hand in Washington—from military men, Congressmen, officials who know the score. Failure to program enough for missile or space development is only one fault named. Another: the President's Budget would cut back on conventional power —manned planes, etc.—before any of the new missiles are ready. Finally, the educational programs envisioned won't produce enough new scientists.

That's why Congress will end up voting more money than has been requested—$2 or $3 billion, to over $76 billion all told. And it won't be a partisan move, either. Plenty from the GOP will join in. Congress can't force the President to spend the extra money it votes. But it is counting on public opinion to do so.

1958 WILL BE A HOT YEAR FOR POLITICS—perhaps the hottest since the President took office. This is only natural in an election year. But the Sputniks were supposed to have brought a change. Bipartisanship was to be the watchword. But now that's all past. The Democrats still plan to work along with Ike on defense. But they don't think he is moving far or fast enough. They plan to exploit what they see as shortcomings in his program.

The Democrats propose to build a record this session that will increase their margin in Congress this year, and pave the way to the White House in 1960. They plan to seize the initiative on policy, expanding and modifying Ike's proposals in every field. They want their label on every law and issue in 1958.

Who will take Congress next Fall? The betting in Washington at this time gives both Houses to the Democrats:

- In the House, they could add 20 seats to their 35-seat edge.
- In the Senate, they could more than double their present two-seat lead. Of 33 seats up for election, more than 20 are now held by Republicans. And 5 of the Democratic seats at stake are coming up in the "safe and solid" South.

CONGRESS MAY EASE THE RULES FOR REPORTING EXPENSES for taxpayers. As things stand, you must report payments by employers in '58 and deductions you are taking. Aim of the Internal Revenue Service crackdown is to collect on the big expense accounts of top executives—some of them really salary. But the average salesman, etc., gets hit with new paperwork in the process.

What may Congress do to ease the burden? One thing that is being considered is exempting expenses that total less than $200 a year from all reporting requirements. Only where the figure was greater would reporting and records be necessary.

NEW WAYS TO RAISE EQUITY MONEY FOR SMALL BUSINESSES are under study jointly by the Small Business Administration, the SEC, and leading bankers. Some of the ideas getting consideration at preliminary stages include:

- Special departments to be set up by stock exchanges and the underwriters to deal in the securities of small companies.
- Development corporations to extend long-term loans to small firms; government would insure capital of private investors.
- Simpler SEC rules to cut red tape on small securities issues.

It's hoped that some concrete action can be taken this year.

(formerly Tenamene 30 and 31)

Eastozone

cuts cost of ozone protection

Rubber products require safeguards against the serious deteriorating effects of ozone. Yet, you may be spending more than you need spend for this protection.

Eastozone—Eastman rubber antiozonants—guard against ozone attack more effectively at *lower cost* than do other types of commercially available antiozonants.

By using Eastozone in rubber recipes, compounders often can cut antiozonants concentration in half and get equal ozone protection, measured by static or dynamic ozone exposure tests. At current prices, this lower concentration can mean a saving of as much as 20¢ on your antiozonant dollar.

Eastozone antiozonants are easily incorporated into the rubber formula during processing. They slowly exude to the surface of the finished rubber product, affording long-lasting protection against checking and cracking caused by atmospheric ozone.

For economical and effective ozone protection, specify Eastman antiozonants for your rubber recipes. Ask your Eastman representative today for samples of Eastozone 30 and Eastozone 31 for evaluation by your laboratory staff, or write to Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, Kingsport, Tennessee.

Chemical Description of Eastman Antiozonants

Eastozone 30	N,N'-di-2-octyl p-phenylenediamine
Eastozone 31	N,N'-di-3-(5-methylheptyl) p-phenylenediamine

(formerly Tenamene 30 and 31)

Eastozone Eastman Rubber Antiozonants

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Massachusetts; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

The lighter side of rubber and plastics . . . colorwise, of course . . . is achieved through TITANOX* white pigments: TITANOX-RA, TITANOX-RA-50, and TITANOX-RA-NC (rutile titanium dioxides), and, for certain rubber compounds such as white sidewall stocks, TITANOX-AMO (anatase titanium dioxide).

Here's why: these leading white pigments lighten and opacify colors, whiten and opacify white stocks, regulate translucency or opacity, and contribute to durability. In addition, they lighten the burden of processing through ease of dispersion and uniformity of all properties. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

5721-A

TITANIUM PIGMENT CORPORATION

Subsidiary of **NATIONAL LEAD COMPANY**

*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

Q

Why permanently-attached couplings?

Four good answers spell better service . . . bigger profits!

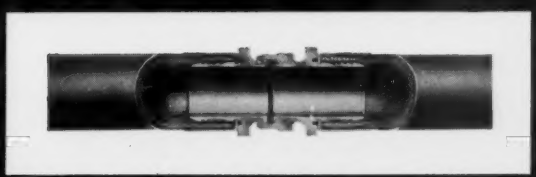
A PERMANENTLY-ATTACHED COUPLINGS COST LESS. And because modern hose is so good . . . lasts so long . . . re-attachable couplings need replacement at about the same time hose does.

A CONTINUING ECONOMY WITH PERMANENTLY-ATTACHED COUPLINGS. Hidden expenses—time, paper work, packing, shipping, etc.—involved in reconditioning of re-attachable couplings eliminated.

A MACHINE-ATTACHMENT ASSURES A MORE PERFECT FIT. Permanently-attached couplings are machine-fitted by experts. You get a permanently fitted coupling every time.

A LEAK-PROOF WITH FULL-FLOW DIAMETER INSIDE. Scovill permanently-attached couplings are made from solid brass forgings and seamless drawn copper tubing to form a strong leak-proof assembly.

For fuel-oil hose . . . permanently-attached couplings by **SCOVILL**



For complete specifications on fuel oil hose couplings write to Scovill Manufacturing Co., Merchandising Division, 88 Mill St., Waterbury 20, Conn. Ask for Bulletin No. 520-H.

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...a great new polymer born of Phillips Research

Phillips Chemical Company, leader in synthetic rubber research, has created a new and distinctive polymer, PHILPRENE 1805. This new rubber fills the need for a *low cost* pigmented rubber with many valuable qualities usually associated only with higher priced polymers.

Philprene 1805 is the result of many thousands of hours of testing and evaluation, plus a greatly improved manufacturing process. High tensile strength, excellent flex life, and resistance to wear and tear make this new polymer a boon to manufacturers of high grade mechanical and industrial rubber products. Philprene 1805 is already taking an important place in the manufacture of camelback.

Introduced experimentally as Philprene 6600, this new rubber is now available commercially. It has been permanently designated Philprene 1805, according to standard ASTM procedure.

Two other new pigmented polymers, made by the same improved process, are now in the experimental stage. Temporarily designated as Philprene 6601 and Philprene 6610, they are designed primarily for tire tread service.

For more information, write for the Philprene brochure or consult your Phillips technical representative.

PHILPRENE 1805 is a non-staining, pigmented, oil-extended cold rubber polymer which contains 75 parts of Philblack** O, a High Abrasion Furnace (HAF) carbon black, and 37.5 parts of a naphthenic type oil.

*A Trademark for Phillips high quality synthetic rubber.

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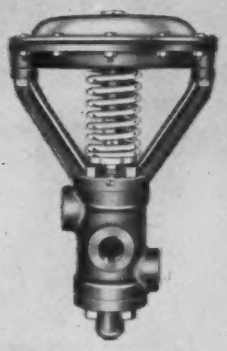

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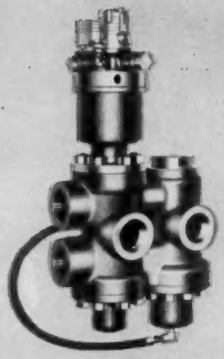

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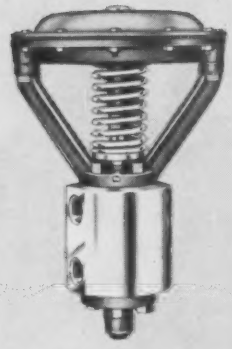

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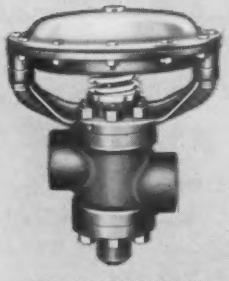

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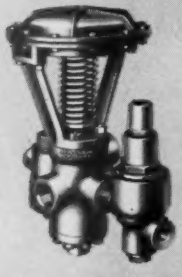

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Impregnated fabric produced by Technical Rubber, Inc., West Haven, Connecticut

Dependable impregnated fabric flexibility at low temperatures is obtained by combining THIOKOL plasticizer TP-90B with synthetic rubber.

For example, in developing the new anti-G suit for supersonic travel, a fabric is required that can withstand tremendous pressures without air leakage. In addition, it must retain its flexibility at the extremely low temperatures of high altitudes. And, to avoid interference with aircraft operation, the anti-G suit fabric must be very light in weight.

A suitable fabric has been developed by coating nylon with many thin applications of a special Neoprene/THIOKOL plasticizer TP-90B compound. Aside from providing the necessary high pressure and low temperature properties, THIOKOL plasticizer acts as an inhibitor against fungus which often causes fabric deterioration in tropical climates.

THIOKOL plasticizer TP-90B is also an ideal low temperature plasticizer for acrylonitrile rubbers, SBR rubber and natural rubber. It provides excellent low temperature properties and has low volatility.

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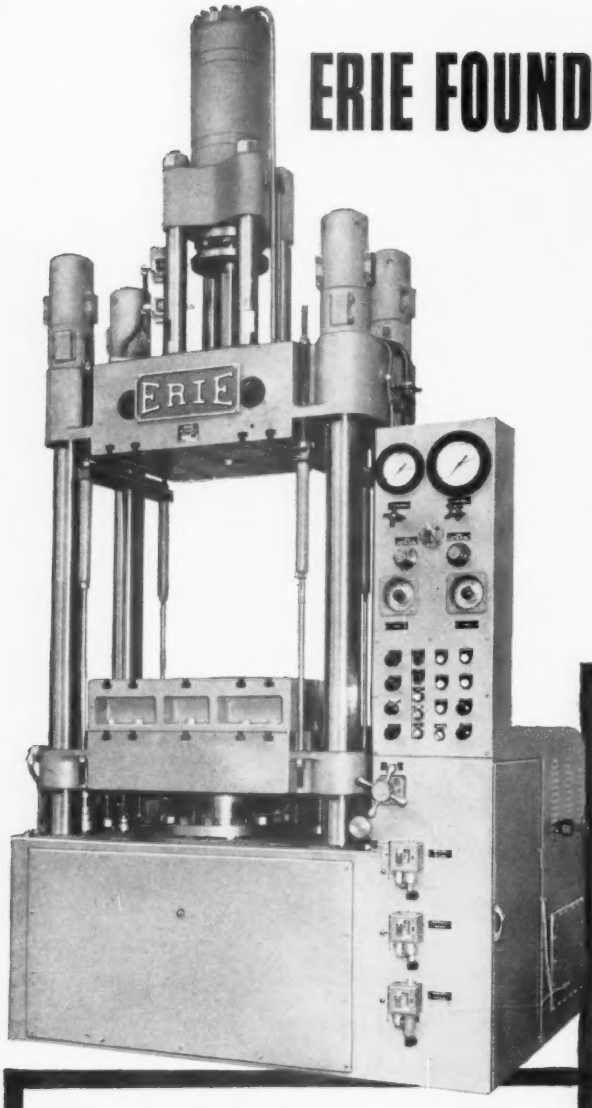
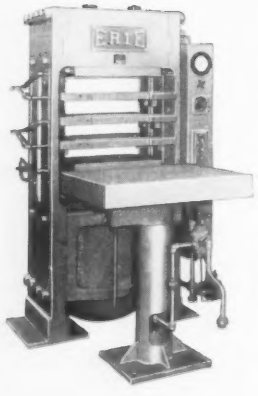
ERIE FOUNDRY HYDRAULIC PRESSES for MOLDING RUBBER and PLASTICS



Hydraulic presses, designed and built by Erie Foundry Company are precision presses in every sense of the word . . . tonnages are accurate and precisely applied, platen temperatures are closely controlled, and molding cycles perform at split second timing. Erie Foundry Hydraulic Presses are flexible too . . . readily adaptable to almost any molding job. Write for complete information on these presses or on the complete line of Erie Foundry rubber and plastic hydraulic presses.

TRANSFER and COMPRESSION MOLDING PRESS

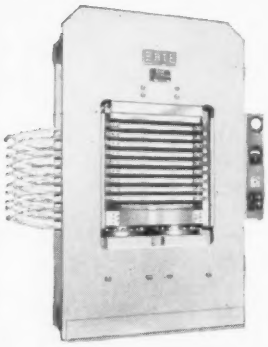
A flexible press for both compression and transfer molding is this 200 ton self-contained semi-automatic Erie press. This machine is equipped with a 55 ton transfer cylinder which can be timed separately from the main ram, as well as knock out cylinders on the bolster and a mechanical knock out for the top mold. Automatic cycling can be easily arranged to mold almost any product.



STRAIN PLATE PRESS for MINIMUM DEFLECTION

The platens stay parallel within .002" on this 314 ton press built of low-stress construction throughout. This press can be converted to transfer molding if desired.

We built the hydraulic lift table, too.



HOT PLATEN PRESS OF ECONOMICAL DESIGN

This 800 ton press is compact and rigid. Accurate platen alignment is maintained with minimum deflection over entire range of platen temperatures.

ERIE

Hydraulic Press Division

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. . . and for prompt service when you need it most . . . you can't beat ASRC!

ASRC offers you highest quality synthetic rubber . . . efficient service that is timed to your needs . . . personal attention to your orders . . . prompt shipments. You will find it pays to rely on ASRC for *quality* products and *quality* service!

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ASRC 1502	Non-Staining	ASRC 1001	Slightly Staining
ASRC 1503	Non-Staining	ASRC 1004	Staining
ASRC 3110	Non-Staining	ASRC 1006	Non-Staining
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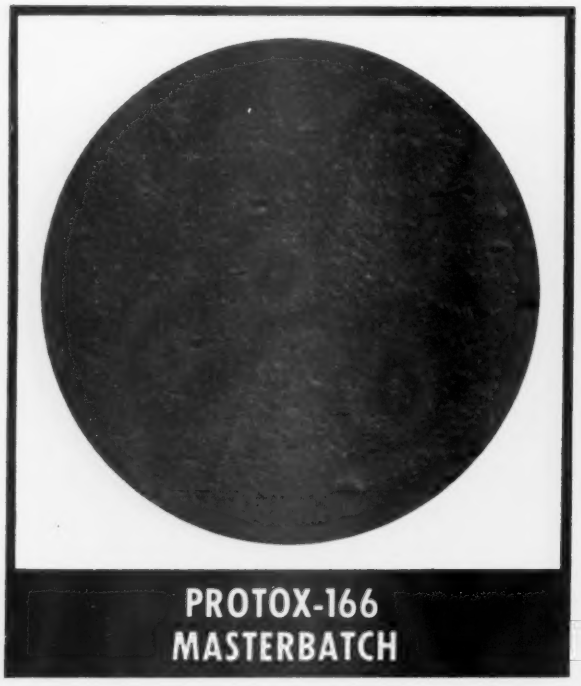
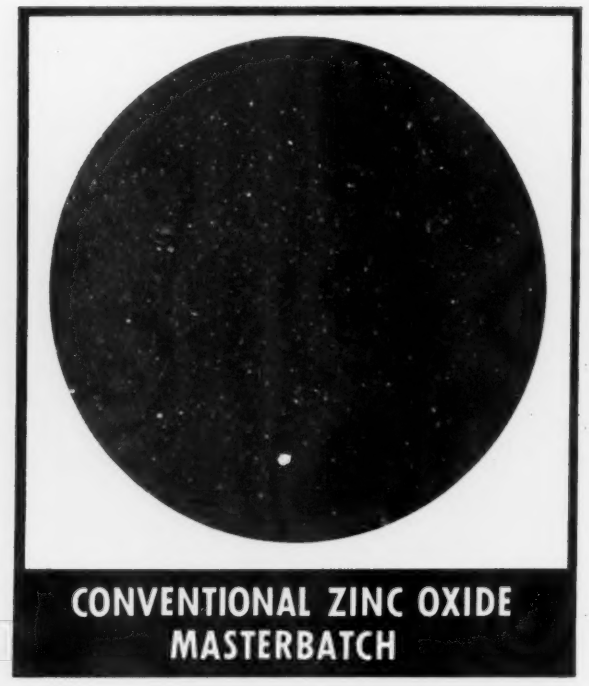


PROTOX-166
MASTERBATCH



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These features stem from the unique coating of zinc propionate on the Protox-166 particles.

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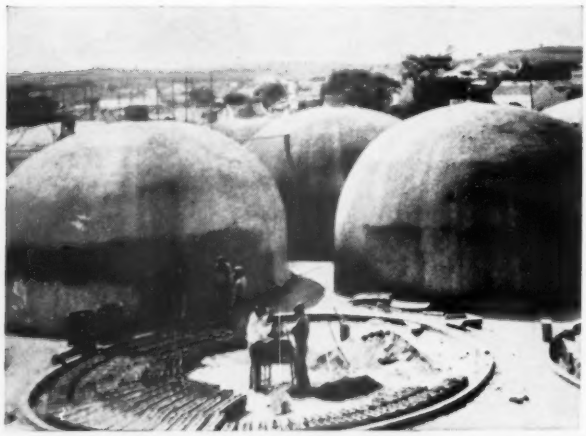
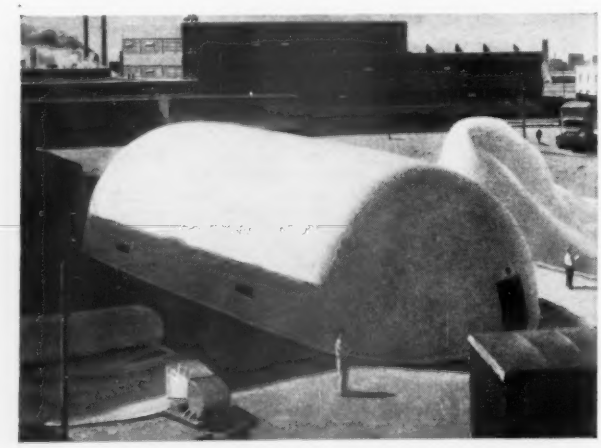


Structure is made by spraying concrete over balloon of rubberized nylon. Nylon base fabric supplied by Wellington Sears.



Welkote, nylon base fabric specifically engineered for vinyl and neoprene coating, is used in inflatable air structure.

A shelter for our continental military defenses, a concrete storage building, an air-supported warehouse—all built with fabric. They represent still another group of new developments in industry made possible by the use of fabric in working combination with plastic, rubber, and other materials.

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For Mechanical Goods, Coated Materials, Tires, Footwear and Other Rubber Products

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means uniformity in cold rubber...

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pioneering • good service • well-packaged • high quality

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This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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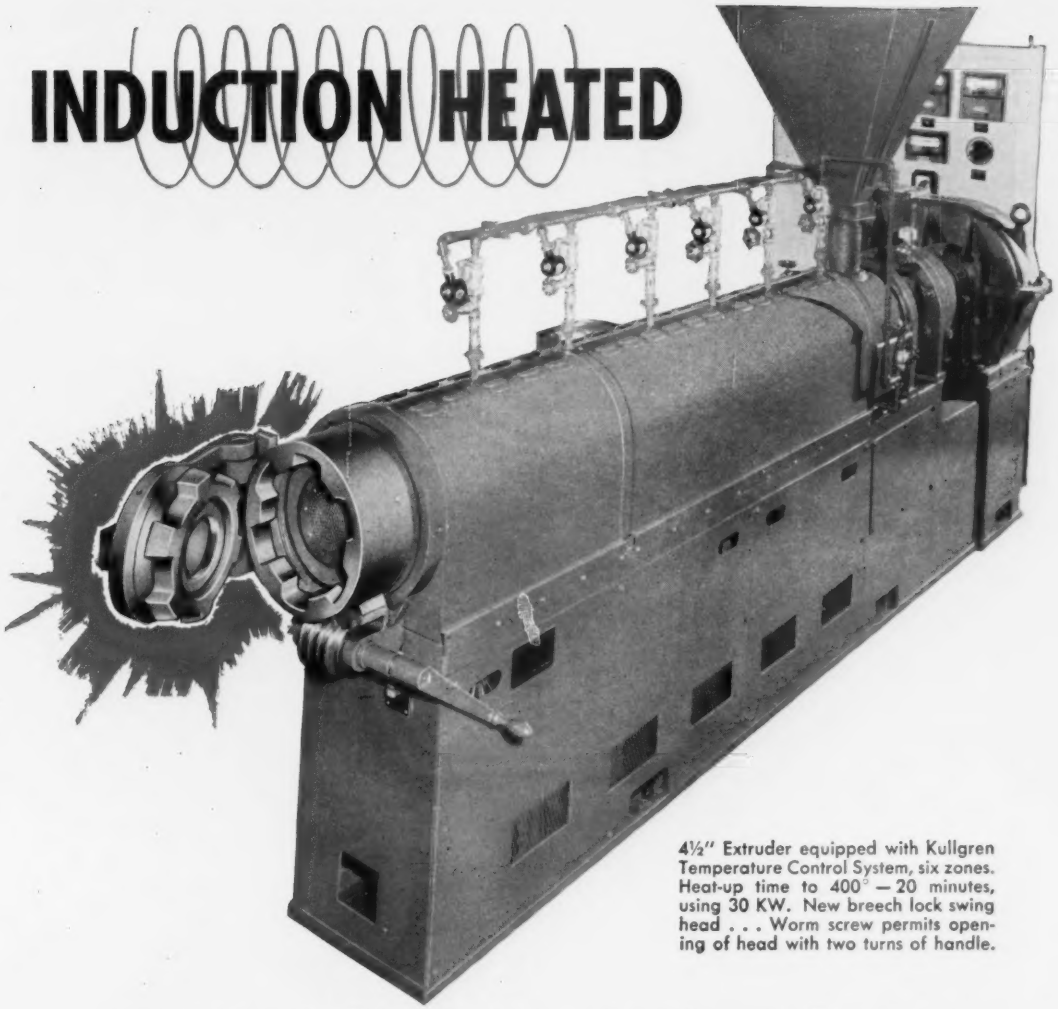

4½" Extruder equipped with Kullgren Temperature Control System, six zones. Heat-up time to 400° — 20 minutes, using 30 KW. New breech lock swing head . . . Worm screw permits opening of head with two turns of handle.

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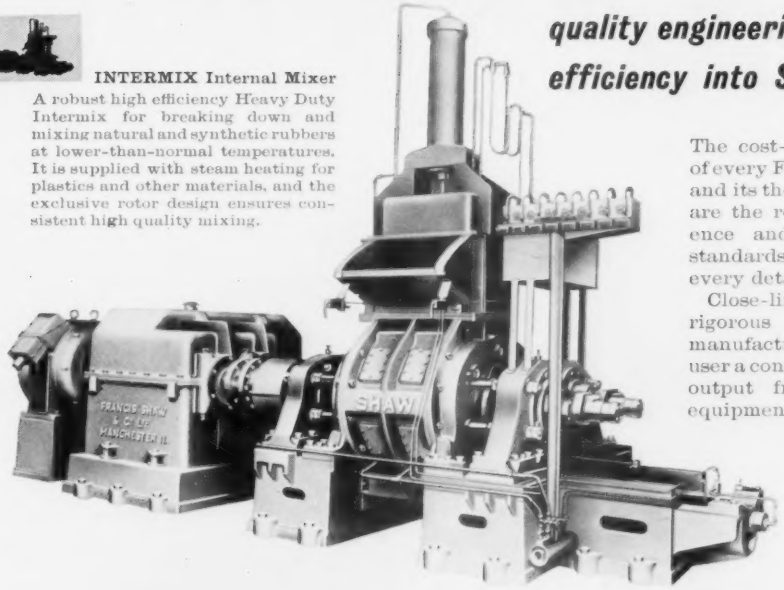

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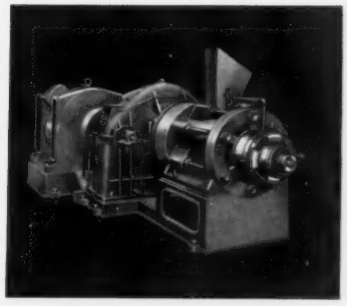

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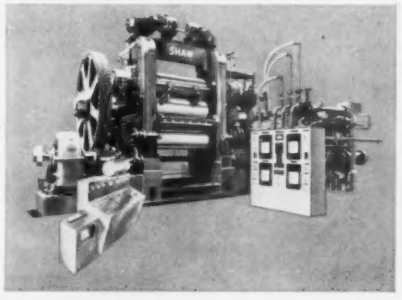

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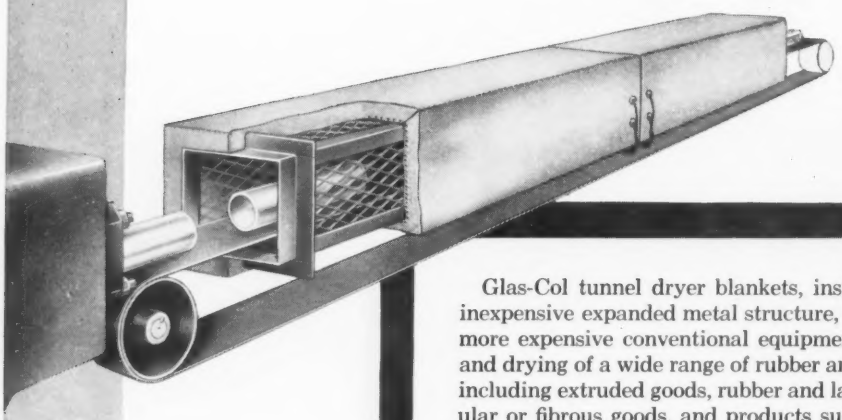

Glas-Col tunnel dryer blankets, installed around an inexpensive expanded metal structure, can do the job of more expensive conventional equipment for the curing and drying of a wide range of rubber and vinyl products including extruded goods, rubber and latex thread, granular or fibrous goods, and products such as mattresses, pillows, and upholstery.

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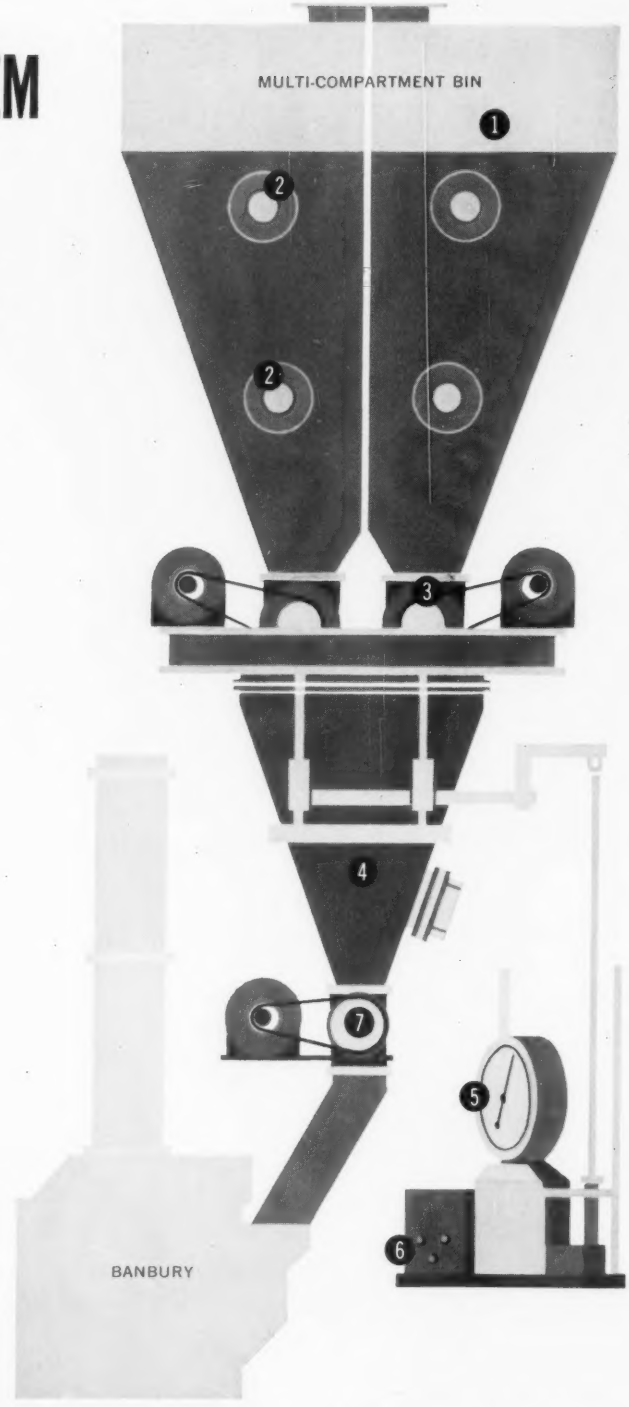

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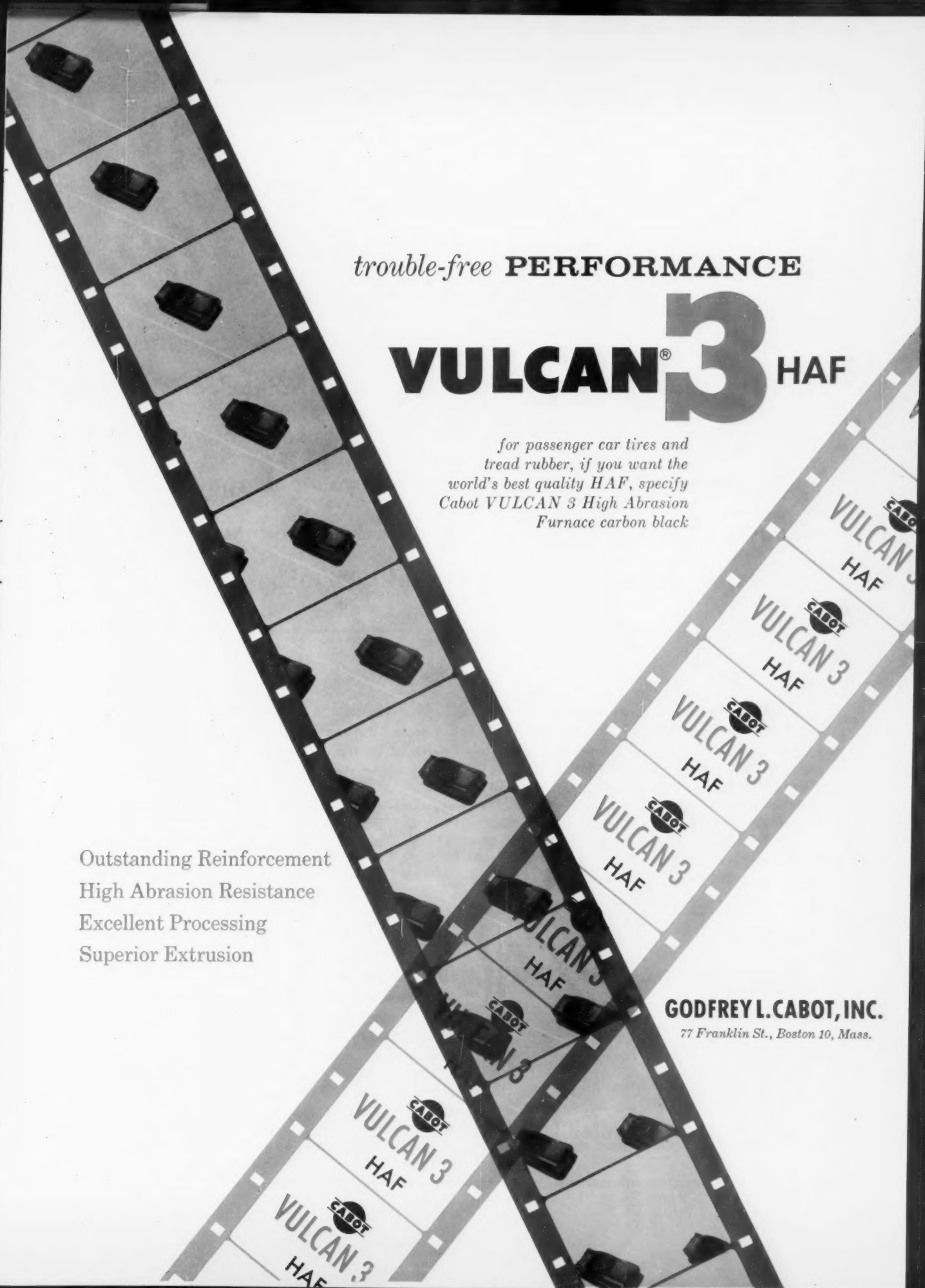

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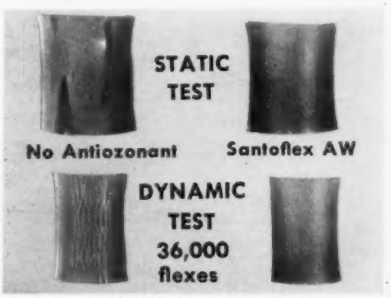
SANTOFLEX® AW . . . antiozonant pioneer guards rubber against cracking caused by ozone attack.

Santoflex AW vaccinates styrene-butadiene rubber, as well as natural and nitrile rubbers, against ozone attack. Like the blooming type of waxes and other antiozonants, Santoflex AW is capable of slow migration to supply a continuous protective barrier. But unlike wax, which is often undesirable and ineffective because the wax film ruptures upon flexing, Santoflex AW retards flex cracking even under dynamic stress. It's the "standard" of the industry.



Santoflex AW protects stock under stress and exposed to 50 parts of ozone per 100 million parts of air for 48 hours.

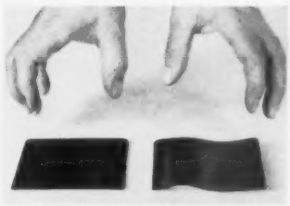
Stock bloomed: 100 parts nitrile rubber, 5.0 zinc oxide, 1.0 stearic acid, 40.0 FEF black, 3.5 Thiurad.®

No bloom. Same stock except Thiurad reduced to 1.5 parts, and 1.5 parts of Sulfasan R added.

SULFASAN® R . . . non-discoloring vulcanizing agent—for part replacement of curing agents—makes possible bloom-free nitrile and butyl stocks with good physical properties.

When Sulfasan R is added in the range of 1 to 2 parts on the nitrile or butyl rubber (conventional vulcanizing agents are cut back, usually by the same amount as the Sulfasan R added), it imparts freedom from bloom, excellent aging and resistance to scorch. In butyl stocks, especially, it greatly improves resistance to compression set. And Sulfasan R is non-discoloring; it can be used in white and light-colored stocks.

You can feel the difference instantly. Stock at right, unmodified butyl. At left, modified with Elastopar.



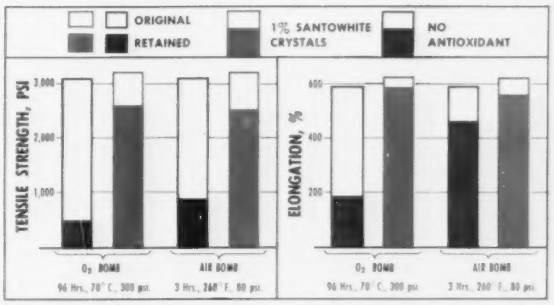
Sample modified by Elastopar, left, flattened completely in 3 seconds. Improved resilience is just one advantage.

ELASTOPAR®. . . chemical modifier puts springy life into butyl rubber—chemically—without heat treatment.

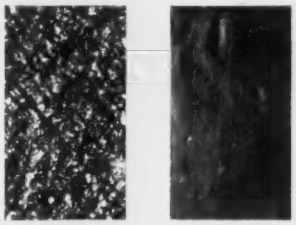
Here are eight other ways Elastopar improves the properties of butyl: vast increase in modulus—no increase in hardness—raises resistance to abrasion—lowers low-temperature flexibility—increases electrical resistivity in carbon black systems roughly from 10^6 to 10^{14}—reduces cold-flow of uncured stocks—lowers Mooney viscosity—does not affect cure.

SANTOWHITE® CRYSTALS . . . unique, bridged-phenol antioxidant protects light-colored rubber and latex.

Although rubber formulations perform differently, here is what you can obtain by adding 1 part per hundred parts of rubber: markedly less loss of tensile strength and elongation from heat exposure; improved retention of resilience over the service life of the compound; retarded stress decay. Most important, of course, is that Santowhite Crystals can be used in white and light-colored stocks based on both natural and most synthetic rubbers; it does not "dye" the compound; is nonstaining to lacquered and enameled surfaces that must contact the finished rubber part.



Results of air bomb and oxygen bomb tests show how effectively Santowhite Crystals protect the original properties of a natural rubber stock.



milled 15 minutes @ 250° F.
Conventional thiazole acceleration
Santocure NS acceleration

SANTOCURE® NS . . . powerful thiazole-type accelerator gives true delayed-action cures to insure rubber against scorch.

15-minutes milling at 250° F. was more than an ordinary thiazole accelerator could stand. It kicked off the cure too soon, causing scorch—often the cause of scrapped stock and defective end products. Santocure NS gives greater safety from scorch, with a true delayed-action cure. It works well in natural, reclaimed or synthetic rubbers. Furnace carbon blacks can be used for reinforcement—do not activate the curing system too greatly for use. Monsanto's Santocure was the first dependably successful delayed-action accelerator introduced for safer processing. Santocure NS has even better delayed action, and *up to 10% less accelerator can be used.* Properly compounded, the rubber has excellent heat resistance, good aging and low compression set.

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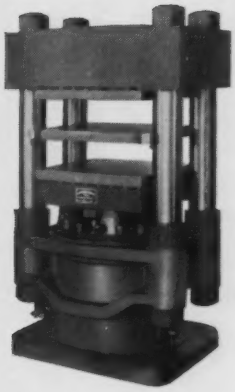

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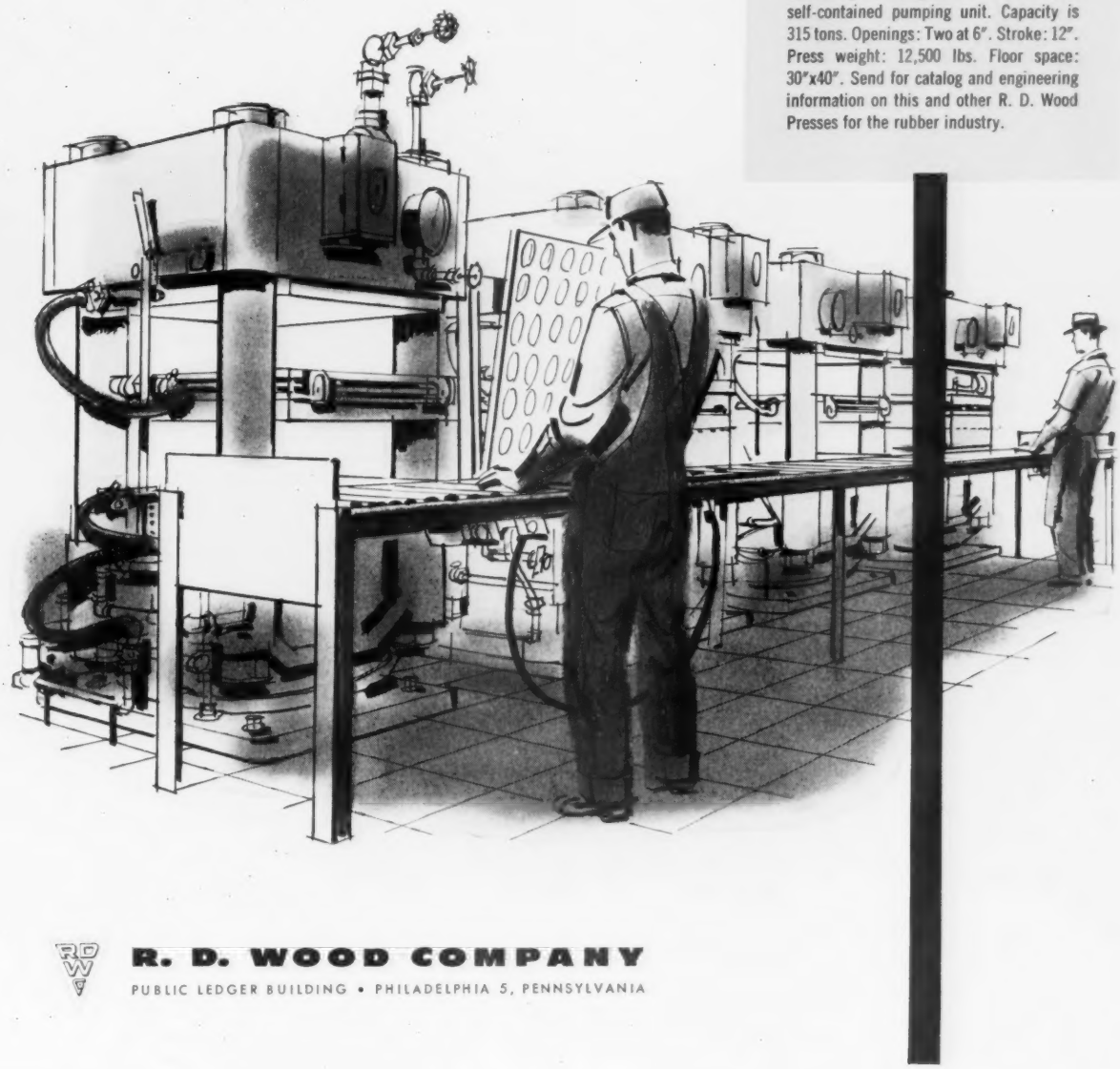

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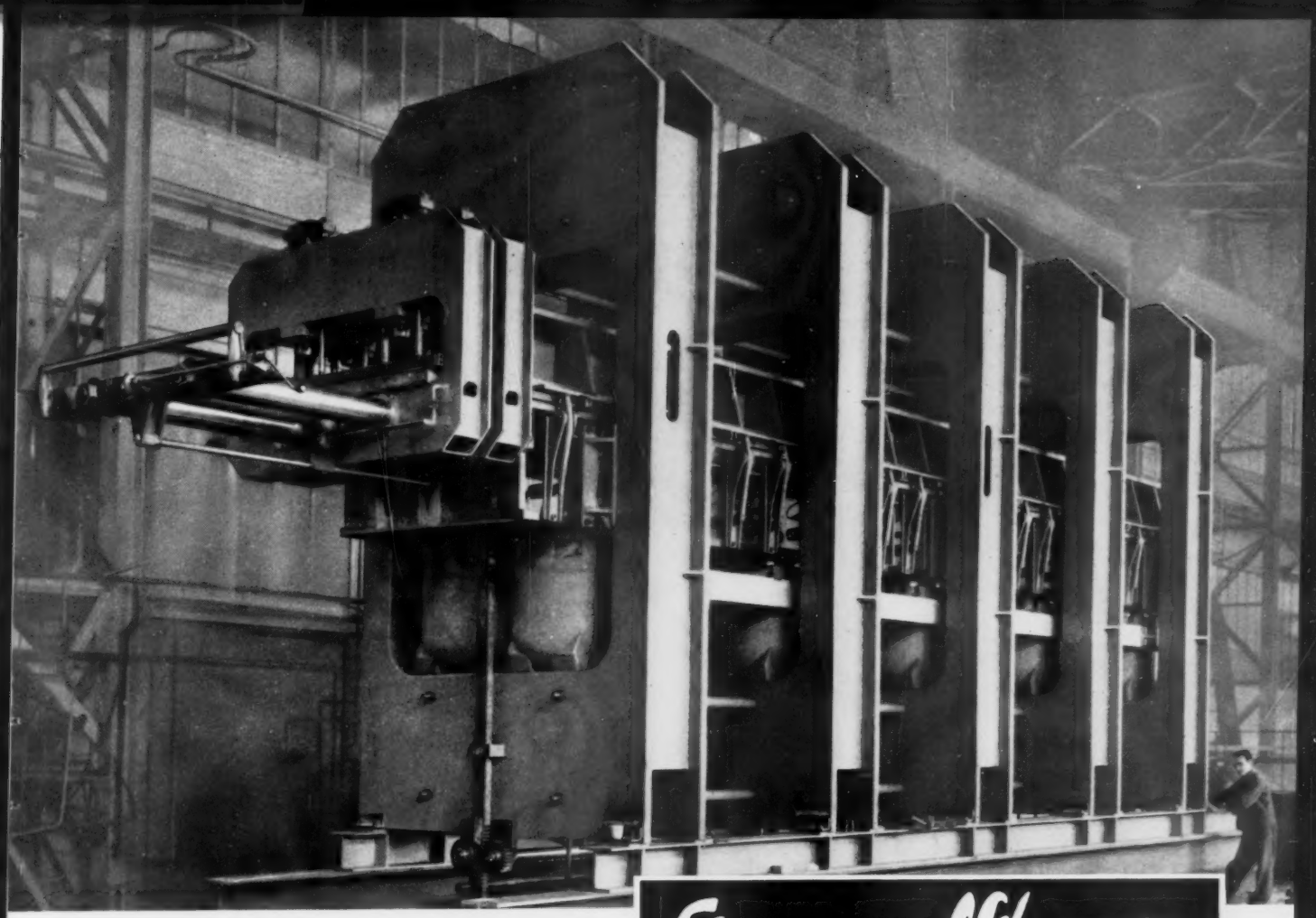

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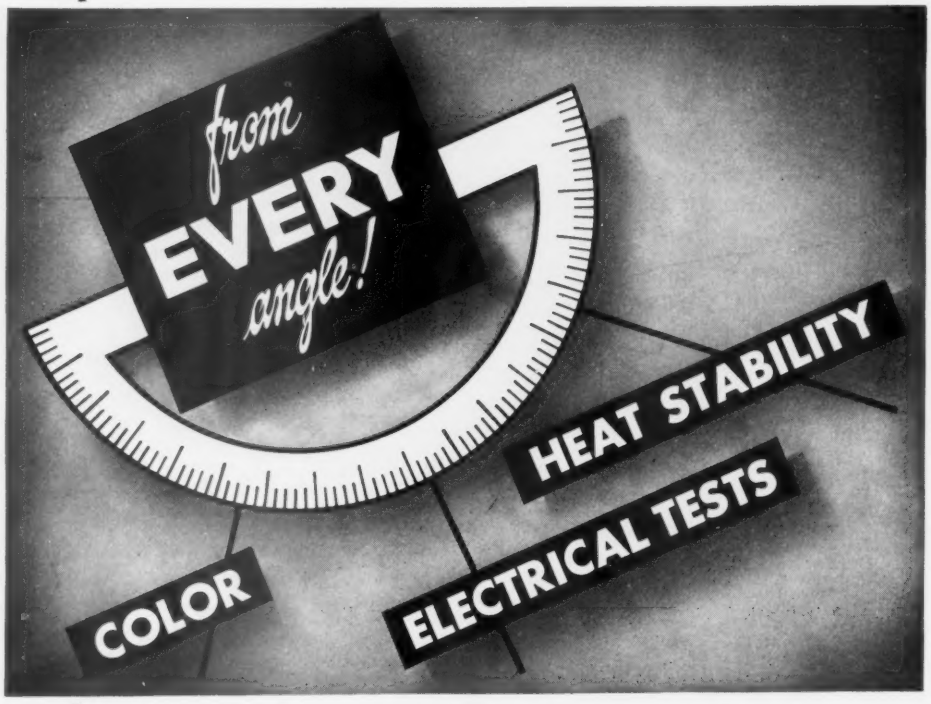

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B-L-E—25 is the improved lower viscosity form of the original B-L-E®. It is especially designed for faster pouring, easier emulsification, better dispersion.

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Thus Paracril OZO provides a unique combination of properties far in excess of ordinary nitrile rubber!

But Paracril OZO is no ordinary nitrile rubber! It is a modified Paracril which incorporates the compounding discoveries of Naugatuck research chemists to which reference has been made in recent Paracril advertisements. The chief modifier is one of Naugatuck's Marvinol® vinyl resins, and the product includes excellent stabilizers for both vinyl and rubber.

Paracril OZO is supplied in the form of small, light-colored flakes, permitting easy handling and considerable flexibility in processing methods.

A most important feature of Paracril OZO is that the vinyl resin in it is completely fluxed during its manufacture. This not only eliminates a difficult compounding procedure on the part of the user but also assures full development of the added properties imparted by the vinyl modifier.

Its unique properties particularly recommend Paracril OZO for wire jackets, shoe soles, coated fabrics, automotive parts, hose and belting jackets. Write for Bulletin No. 219 which contains compounding suggestions and interesting test data on Paracril OZO vulcanizates.

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Rubber Age

Vol. 82, No. 6 March, 1958

By ROBERT HARRINGTON
Hanford Laboratories Operation,
General Electric Co., Richland, Wash.

Elastomers for Use in Radiation Fields

Part III: Effects of Gamma Radiation on Elastomers

classified chemically as acrylic, chlorosulfonated polyethylene, chloroprene, nitrile and styrene

THE first article in this series provided general background information on the subject of radiation damage to organic polymers, outlined the method of measuring physical property changes, presented two sections concerning some basic considerations (post irradiation effects and effect of dose rate), and also included a section on the stress cracking of elastomers induced by gamma radiation *(1)*. The second article discussed the effects of gamma radiation on elastomers which were broadly classified as heat resistant *(2)*.

This article presents data and discussion on the effects of gamma radiation on materials chemically classified as acrylic, chlorosulfonated polyethylene, chloroprene, nitrile, and styrene elastomers, and is a continuation of the work undertaken to procure engineering data for practical application of elastomers and rubberlike plastics in various devices and components used in radiation fields.

Materials Evaluated and Experimental Procedure

The materials used for the gamma irradiation studies reported herein are listed in Table I. They are grouped in accordance with the general chemical type of the base polymer used in each material, and where possible a brief description is given. The materials which are not proprietary items are described more completely in Table II-A through II-E which gives recipes and cure schedules.

The information given in Table II is of prime interest in that it offers the reader an opportunity to assess the role the various compounding materials have on the resistance of the base polymer to the effects of radiation. It also offers an opportunity to compare the radiation resistance of one base polymer with another of the same chemical type. This is exemplified by the series of Hycar nitrile copolymers which all have the same recipe but differ in acrylonitrile content. Born *(3)* and Fleming *(4)* have also carried out studies on the effects of radiation on these materials.

The studies reported herein were designed to provide information on the room temperature radiation resistance of the elastomers for screening purposes, for engineering data, and for future use when the irradiations will be made at higher temperatures and in other environments.

All materials were exposed to gamma radiation and evaluated by recording changes in physical properties as described previously *(1)*. For all irradiations up to and including 1×10^8 r a Colbalt-60 isotope source at Hanford was used. For the higher irradiation spent fuel elements of the Materials Testing Reactor (MTR) were used. This latter source was used for the higher doses because the higher dose rates obtainable at the MTR very significantly reduced the amount of irradiation time. The results obtained from the irradiation of the same material to the same dose from both sources agree closely enough so that it can be assumed that the experimental results obtained are independent of the two sources *(1)*.

The data obtained from exposing the materials listed in Table I to various doses of gamma radiation in air at 25°C. at normal atmospheric pressure are presented in Table III. This table shows physical property changes induced by exposure to gamma radiation as percent decrease (minus sign) or percent increase (no sign) of the original property values which are given opposite zero irradiation dose. Also shown opposite zero irradiation dose and under the "Remarks" column is the original color of each material. Significant color changes and other observations needing comment are also noted in this column opposite the particular radiation dose causing the phenomenon. A portion of the data tabulated in Table III has been previously published *(5, 6)*.

Experimental Results

The data presented in Table III show how radiation affects the physical properties of the various elastomers chosen for these studies. In most cases short doses, and in some instances, intermediate doses, do not affect the usefulness of the materials to any great extent; but on continued exposure all of the materials examined are more or less severly damaged depending upon their chemical composition and compounding ingredients. The data also afford the opportunity of comparing the effects of ionizing radiation on different classes of materials as well as on materials within a class. This will be discussed in more detail on the following pages. Additional information on the effects of ionizing radiation can be obtained in several excellent articles in the literature. Typical examples of these have been listed previously *(2)*.

TABLE I—ELASTOMERS USED FOR GAMMA IRRADIATION STUDIES

Material Supplier and Designation	Type or Description
ACRYLICS	
Borden Chemical Co.	
Acrylon BA-12*	Copolymer of 88% butyl acrylate and 12% acrylonitrile.
Acrylon EA-5*	Copolymer of 95% ethyl acrylate and 5% acrylonitrile.
Monsanto Chemical Co.	
Vyram*	Not known.
Precision Rubber Products Corp.	
PR 1203-70	Not known.
B. F. Goodrich Chemical Co.	
Hycar 4021*	Copolymer of 95% ethyl acrylate and 5% chloroethyl vinyl ether.
Hycar 2121x26-1*	Copolymer of 95% ethyl acrylate and 5% acrylonitrile.
Hycar 2121x26-2*	Copolymer of 95% ethyl acrylate and 5% acrylonitrile.
Hycar 2121x26-3*	Copolymer of 95% ethyl acrylate and 5% acrylonitrile.
Hycar 2121x26-4*	Copolymer of 95% ethyl acrylate and 5% acrylonitrile.
Hycar 2121x27-1*	Copolymer of 90% butyl acrylate and 10% acrylonitrile.
Hycar 2121x27-2*	Copolymer of 90% butyl acrylate and 10% acrylonitrile.
Hycar 2121x27-3*	Copolymer of 90% butyl acrylate and 10% acrylonitrile.
Hycar 2121x27-4*	Copolymer of 90% butyl acrylate and 10% acrylonitrile.
CHLOROSULFONATED POLYETHYLENES	
DuPont Elastomer Chemicals Dept.	
Hypalon S-2	Hypalon S-2 base polymer used.
Hypalon A2411A-277*	Hypalon 20 base polymer used.
Hypalon A2411A-391*	Hypalon 20 base polymer used.
Hypalon A2109D-3**	Hypalon 20 base polymer used.
Hypalon HW-B7*	Hypalon 20 base polymer used.
Hypalon HW-B8*	Hypalon 20 base polymer used.
Hypalon HW-B9*	Hypalon 20 base polymer used.
Precision Rubber Products Corp.	
PR 1401-70	Hypalon 20 base polymer used.
CHLOROPRENES	
U. S. Rubber Co.	
M-3854	Not known.
M-3871	Not known.
Precision Rubber Products Corp.	
PR 227-70	Not known.
DuPont Elastomer Chemicals Dept.	
Neoprene A9A-35*	Neoprene Type GN polymer used.
Neoprene A411A-1313*	Neoprene Type W polymer used.
Neoprene A411A-1444*	Neoprene Type W polymer used.
Neoprene A411A-1757*	Neoprene Type W polymer used.
Neoprene A411A-1758*	Neoprene Type W polymer used.
Neoprene A411A-1759*	Neoprene Type W polymer used.
Neoprene A411A-1760*	Neoprene Type W polymer used.
Neoprene A109D-71*	Neoprene Type WRT polymer used.
Neoprene A109D-72*	Neoprene Type WHV polymer used.
Neoprene A109D-73*	Neoprene Type W polymer used.
Neoprene A109D-74*	Neoprene Type W polymer used.
Neoprene A109D-75*	Neoprene Type W polymer used.
NITRILES	
Precision Rubber Products Corp.	
PR 122-70	Copolymer of butadiene and acrylonitrile based on Hycar 1042.
PR 142-70	Copolymer of butadiene and acrylonitrile based on Hycar 1002.
Parker Appliance Co.	
46-101	Copolymer of butadiene and acrylonitrile based on Paracril 35.
1063-16	Copolymer of butadiene and acrylonitrile based on Hycar 1002.
Linear, Inc.	
7505-70	Copolymer of butadiene and acrylonitrile.
7513-80	Copolymer of butadiene and acrylonitrile.

*See Table II for complete details on recipe used and cure schedule; **Same formulation used in A2411A-277.

TABLE I—ELASTOMERS USED FOR GAMMA IRRADIATION STUDIES *(Cont'd.)*

Material Supplier and Designation	Type or Description
NITRILES (Cont'd).	
B. F. Goodrich Chemical Co.	
Hycar 1000x88-1*	Copolymer of butadiene and acrylonitrile.
Hycar 1000x88-2*	Copolymer of butadiene and acrylonitrile.
Hycar 1001*	Copolymer of 60% butadiene and 40% acrylonitrile.
Hycar AR*	Same as Hycar 1001 with the addition of an "anti-rad."
Hycar 1002*	Copolymer of 67% butadiene and 33% acrylonitrile.
Hycar 1042*	Copolymer of butadiene and acrylonitrile.
Hycar 1042-P*	Same as Hycar 1042 with the addition of a phenolic resin.
Hycar 1072*	A carboxylic modified Hycar 1042.
Hycar 1043*	Copolymer of butadiene and acrylonitrile.
Hycar 1014*	Copolymer of butadiene and acrylonitrile.
Hycar 1014x11*	Copolymer of butadiene and acrylonitrile.
Hycar 1041*	Copolymer of butadiene and acrylonitrile.
STYRENE ELASTOMERS	
Precision Rubber Products Corp.	
PR 408-70	Copolymer of butadiene and styrene.
PR 430-X24	Copolymer of butadiene and styrene.
PR 430-X27	Copolymer of butadiene and styrene.
B. F. Goodrich Chemical Co.	
Hycar 2001*	Copolymer of butadiene and styrene.
Hanford Experimental Material	
HW-B10*	Copolymer of butadiene and styrene; GR-S 1500 polymer used.

*See Table II for complete details on recipe used and cure schedule; **Same formulation used in A2411A-277.

A study of the data in Table III shows that the styrene-butadiene materials are somewhat superior in their resistance to the damaging effects of ionizing radiation as compared with the other classes of materials under investigation. The acrylics are rated second best, but only slightly better than the other classes. The materials comprising the chlorosulfonated polyethylenes (Hypalons), chloroprenes (neoprenes), and the nitriles appear in general to be of the same order of magnitude in resistance to radiation.

There is, however, a great deal of overlapping among the various classes of materials as well as materials within a class. For example, Acrylon EA-5 is more radiation resistant than the styrene rubber PR 430-X24, which in turn is far less resistant than another styrene rubber PR 408-70. This apparent widespread degree of resistance to radiation is due in part to the difference in the basic polymers and in part due to the compounding materials used in each material formulation. Hypalons HW-B9 and A2411A-277 exhibit different resistances to radiation because they are compounded differently while Hycars 1002 and 1072 are different because of differences in their base polymers. The neoprenes and the acrylics, on the other hand, are quite different because of the polymer differences within each of these two classes.

Graphic representations of how the above classes of materials are affected by gamma radiation are shown in Figures 1 through 5. As space limitations imposed by the large number of materials evaluated preclude a graph of each one, the illustrations are meant to show the changes in a material which is in general typical of its group. Acrylon EA-5 might be considered typical of the acrylics, Hypalon HW-B8 is in general representative of the chlorosulfonated polyethylenes, Neoprene A411A-1757 is selected as representative of the chloroprenes, PR 122-70 is in general typical of the nitriles, and PR 408-70 exemplifies the radiation resistance of the styrene rubbers. A more detailed discussion of the individual classes will follow which will point out discrepancies which occur where particular compounds within a class are not accurately represented by these illustrations.

The two basic effects caused by the ionizing radiation of elastomers—cross-linking and chain cleavage or scission (often referred to as degradation)—will be discussed below on the basis of interpretation of the physical property changes. The more direct approach to determining whether or not materials undergo cross-linking or chain cleavage utilizes infrared and mass spectrometer techniques. This approach which shows chemical changes occurring in organic polymers induced by ionizing radiation will be included in this series of articles in the future.

The first article in this series *(1)* discussed the stress cracking of certain elastomers which was first noted when samples were stapled together for convenience in handling, the cracking occurring around the point where the staple pierced the rubbers causing excessive stress. Under the "Remarks" column in Table III the first dose at which stress marks were noted is indicated. Stress marks were also observed at the higher doses but were not recorded in the table. However, as all specimens were not stapled, stress marks could have occurred in other materials if they had been stressed. For example, stress cracks were observed in Hycar 1001 at doses of 5×10^5 r and higher, but no notation was recorded for Hycar 1002 as this material was not stressed during the irradiations. This does not therefore indicate that Hycar 1002 is resistant to radiation induced stress cracking.

Property changes of typical elastomers induced by gamma radiation in air at 25°C. at normal atmospheric pressure.

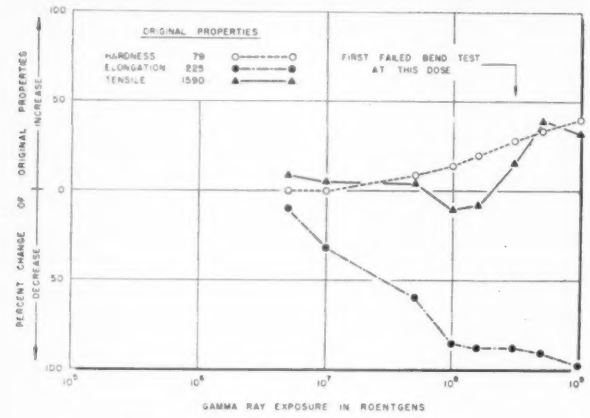

FIG. 1—Acrylic elastomer (Acrylon EA-5).

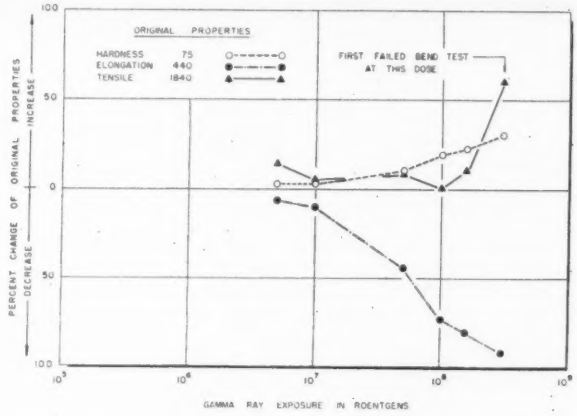

FIG. 2—Chlorosulfonated polyethylene elastomer (Hypalon HW-B8).

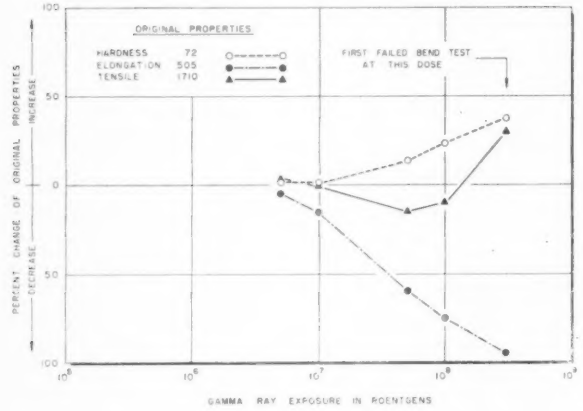

FIG. 3—Chloroprene elastomer (Neoprene A41IA-1757).

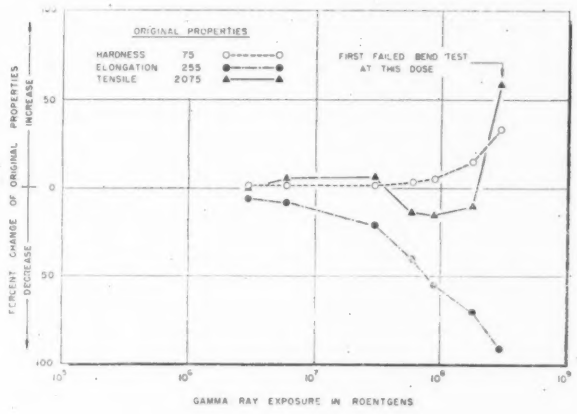

FIG. 4—Nitrile elastomer (PR 122-70).

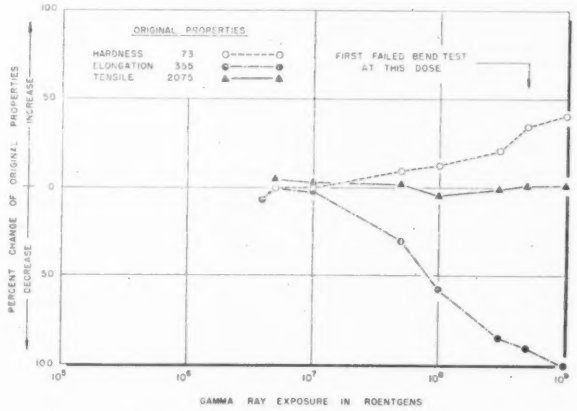

FIG. 5—Styrene elastomer (PR 408-70).

Acrylics

The materials studied in the acrylics group represent compounds based on three known types of polymers and two unknown base polymers, the latter being Vyram and PR 1203-70. Therefore, this discussion of acrylic materials will be primarily concerned with the butyl acrylate and ethyl acrylate-acrylonitrile copolymers and with the ethyl acrylate-chloroethyl vinyl ether copolymer as typified by the Acrylon and Hycar materials described in Tables I and II-A.

All of the butyl rubber and ethyl acrylate materials appear to behave in a very similar manner. The hardness increases with increasing radiation exposure while the elongation decreases. The tensile strength, as observed in ten materials, in general increases or decreases after short exposures, remains relatively unchanged through intermediate doses, then drops and eventually increases with prolonged exposures. The tensile behaves very similarly for these materials with the exception of variations in the magnitude and direction (increase or decrease) of change. This is attributed to the effect the compounding ingredients have on the polymers rather than differences among the polymers themselves. It appears, therefore, that these two types of polymers behave in the same manner when subjected to gamma radiation, and it is the manner in which they are compounded which gives each material its individual traits.

The compounding materials for the butyl and ethyl acrylate copolymers appear to affect the radiation resistance of these rubbers to only a small degree. The four

best compounds (Hycars 2121x26-4 and 2121x27-4; Acrylons BA-12 and EA-5) of the ten Hycar 2121x series and Acrylons studied were all cured with a sulfur-stearic acid-triethylene tetramine system and were loaded with a semi-reinforcing furnace carbon black. Acrylon EA-5 is comparable to Hycar 2121x26-4 both in chemical composition, recipe, and in radiation resistance trends while the same holds true for Acrylon BA-12 and Hycar 2121x27-4. Figure 6 graphically illustrates the similarity of physical property changes induced in these two materials from exposure to gamma radiation.

Hycar 4021, a copolymer of ethyl acrylate and chloro vinyl ether, differs chemically from the ten materials just discussed and is also affected differently by radiation. The difference is chiefly in the effects on the tensile strength, which is lowered considerably at short and intermediate doses before assuming an upward trend. Because of the evaluation of only one material of this type, it is not known whether the cure system and loading or the base polymer is primarily responsible for the tensile strength behavior.

The data presented on the acrylics as a whole indicate that out to about 1 x 10^8 r the materials could be undergoing slight amounts of both cross-linking and chain cleavage with the latter predominating in most materials because of the tensile strength decreases. After that dose, it appears that cross-linking is predominating as shown by tensile strength increases. The Acrylons were the only materials taken out to a dose of 1 x 10^9 r where they became quite stiff and brittle. After a dose of 5 x 10^8 r their tensile strength began to decrease, which is indicative of the predominance of chain cleavage. However, it might be possible that this reduction was due to a great increase in the rate of cross-linking which is the case in other materials studied *(7)*. There was no evidence of stress cracking in any of the materials at any dose.

In the foregoing discussion (as in the discussions to follow) the term "polymer" has been used several times in reference to a base elastomeric material (the gum rubber) which was in reality a "copolymer". This was done simply because it was felt that less confusion would arise by always using the same terminology. Thus, polymer is used in the broad sense in referring to one, two, or three component polymers. Table I lists the actual type of base material used, for example, polymer, copolymer, terpolymer, mixture, blend, etc.

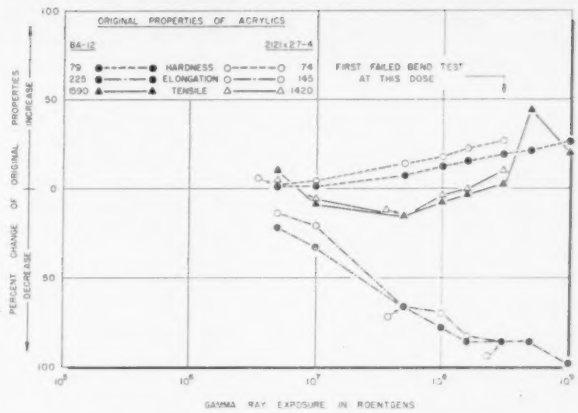

FIG. 6—Similarity in radiation resistance of two comparable acrylic elastomers as reflected by physical property changes induced by gamma radiation in air at 25°C. at normal atmospheric pressure.

Chlorosulfonated Polyethylenes

The Hypalon (chlorosulfonated polyethylene) materials which were studied consisted of five different compounds whose recipe was known and two propietary materials, one of which was the first Hypalon polymer S-2. Hypalons A2411A-277 and A2109D-3 are iden-

TABLE II-A—RECIPES OF ACRYLIC ELASTOMERS USED FOR GAMMA IRRADIATION STUDIES

Acrylons cured 30 min. at 310°F.; Vyram cured 30 min. at 330° F.; all others cured 30 min. at 310°F., post cured 24 hours at 300°F.

	Acrylon			Hycar	Hycar 2121x26-				Hycar 2121x27-			
Recipe Materials	BA-12	EA-5	Vyram	4021	1	2	3	4	1	2	3	4
Acrylon BA-12	100.0	—	—	—	—	—	—	—	—	—	—	—
Acrylon EA-5	—	100.0	—	—	—	—	—	—	—	—	—	—
Vyram	—	—	100.0	—	—	—	—	—	—	—	—	—
Hycar 4021	—	—	—	100.0	—	—	—	—	—	—	—	—
Hycar 2121x26	—	—	—	—	100.0	100.0	100.0	100.0	—	—	—	—
Hycar 2121x27	—	—	—	—	—	—	—	—	100.0	100.0	100.0	100.0
SRF Black	50.0	50.0	—	—	—	—	—	—	—	—	—	—
FEF Black	—	—	—	40.0	40.0	40.0	40.0	—	40.0	40.0	40.0	—
CC Black	—	—	30.0	—	—	—	—	—	—	—	—	—
Stearic Acid	1.0	1.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sulfur	1.0	1.0	—	—	—	1.0	0.5	1.0	1.0	0.5	—	1.0
TETA	2.0	1.0	—	1.5	1.5	1.5	—	1.5	1.5	—	1.5	1.5
Benzothiazial disulfide	—	—	—	2.0	—	—	—	—	—	—	—	—
Silica	—	—	10.0	—	—	—	—	—	—	—	—	—
Oleic Acid	—	—	1.0	—	—	—	—	—	—	—	—	—
Magnesium Oxide	—	—	10.0	—	—	—	—	—	—	—	—	—
Divinyl Benzene	—	—	3.0	—	—	—	—	—	—	—	—	—
Dicumyl Peroxide (40% active)	—	—	3.0	—	—	—	—	—	—	—	—	—
Sterling S	—	—	—	—	—	—	—	50.0	—	—	—	50.0
TMTD	—	—	—	—	2.0	—	—	—	—	—	2.0	—
Trimene base	—	—	—	—	—	—	3.0	—	—	3.0	—	—

TABLE II-B—RECIPES OF CHLOROSULFONATED POLYETHYLENE ELASTOMERS USED FOR GAMMA IRRADIATION STUDIES

Cures: 30 min. at 302°F.

	—Hypalon A2411A-		— Hypalon HW-		
Recipe Materials	277	391	B7	B8	B9
Hypalon 20	100.0	100.0	100.0	100.0	100.0
Staybelite Resin	2.5	2.5	—	5.0	5.0
NBC	1.0	1.0	—	1.0	1.0
Antox	2.0	2.0	—	—	—
Litharge	40.0	20.0	20.0	20.0	20.0
SRF Black	30.0	—	10.0	—	45.0
MBTS	.5	.5	2.0	.5	.5
Tetrone A	.75	.75	—	.75	.75
AC Polyethylene #617-A	—	5.0	—	—	—
Precipitated Whiting	—	20.0	—	45.0	—
Magnesia	—	10.0	10.0	10.0	10.0
Coray 230	—	5.0	—	—	—
MT Black	—	5.0	—	—	—
Stearic Acid	—	—	10.0	—	—
Agerite Resin D	—	—	2.0	2.0	2.0
Kenflex A	—	—	—	10.0	10.0

Note: Hypalon A2411A-277 and A2109D-3 are identical.

tical and were evaluated to study batch to batch uniformity of the compounds as well as reproducibility of the radiation exposures.

All of the materials investigated in general are affected quite similarly with respect to hardness, which increases, and elongation, which decreases with continued radiation exposure. The tensile strength, on the other hand, does not always behave in a definite pattern. Essentially the tensile strength follows two trends: one, it remains fairly constant (at values approximating the original and greater) out to about 1×10^8 r after which it continues to increase with increasing exposure, and two, it is increased at early doses, drops considerably at about 5×10^7 r and then continues to increase on continued exposure.

Only general statements can be made concerning the effects the compounding materials have on the Hypalon polymer because of the limited number of compounds evaluated and the large number of variables introduced by the many compounding ingredients. Taking into account flexibility and retention of properties, compounds HW-B8 and HW-B9 were superior, and the other three (A2411A-277, A2411A-391, and HW-B7) about equal.

A study of the recipes of these materials given in Table II-B suggests that the aromatic plasticizer Kenflex A contributes to the good radiation resistance of compounds HW-B8 and HW-B9. These two materials differ only in the kind of filler loading used and this difference in loading appears to have no effect on the radiation resistance of Hypalon. This agrees with results of other studies being conducted on types and amounts of reinforcing agents *(7)*. Antioxidants alone seem to have no appreciable effect, as HW-B7 (with the least amount) was as equally damaged as A2411A-277 and A2411A-391 (with greater amounts). No attempt at this time will be made to assign the role played by the cure system alone or in combination with the other materials because of the many variables involved.

A comparison of Hypalons A2411A-277 and A2109D-3 which are identical materials but were made up about six months apart shows both the batch to batch uniformity of the materials and the reproducibility of the radiation exposures and physical tests. This seems of some importance considering the many variables involved—materials, testing of properties and exposure dose—each of which is subject to limits of reproducibility and accuracy. Figure 7 illustrates the radiation induced changes in these two materials.

The Hypalons appear to be undergoing cross-linking at short and long exposures, as indicated by increases in hardness and tensile strength, with the exception of a few materials whose tensile strength was lowered at intermediate doses. This could either be indicative of a slight amount of chain scission or a result of the effect of some of the compounding ingredients. The variations in tensile strength, both kind and degree, appear certainly to be in part a function of these recipe materials. There was no evidence of stress cracking in any of the materials at any exposure.

Chloroprenes

A total of fifteen different neoprene (chloroprene) materials were investigated—three proprietary materials and twelve whose recipes were known. This discussion is accordingly concerned with these latter compounds. This current work on the neoprenes will be supplemented at a later date. At that time more information on the types of neoprenes and chemical changes will be given.

The neoprenes, like the Hypalons and many other materials discussed previously, increase in hardness and decrease in elongation with increasing radiation exposure. The tensile strength behavior, also reflected in many of the other materials, does not follow a definite pattern. The variation is rather small and could almost be one of degree rather than kind. Only four materials showed this difference—A9A-35, PR 227-70, M-3854 and M-3871. Using A9A-35 as an example, it would appear that the red lead cure and type of neoprene polymer are responsible for the tensile strength increasing at short doses, then dropping at about 5×10^7 r, and finally increasing with continued exposure.

Compound A109D-73 is quite similar to A9A-35 but

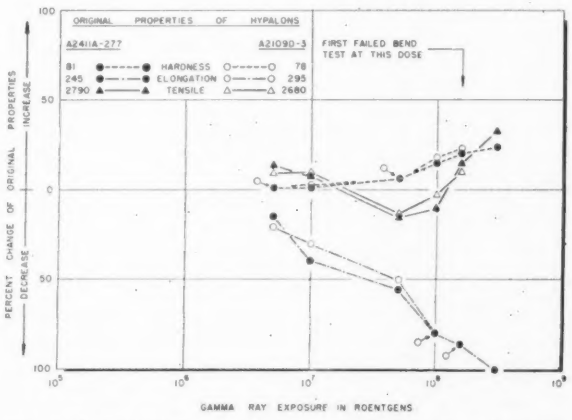

FIG. 7—Reproducibility of physical property changes induced by gamma radiation on two identical chlorosulfonated polyethylene elastomers exposed in air at 25°C. at normal atmospheric pressure at two different times.

TABLE II-C—RECIPES OF CHLOROPRENE ELASTOMERS USED FOR GAMMA RADIATION STUDIES

Compounds A411A-1313 and 1444 cured 20 min. at 307°F.; A411A-1757 through 1760 15 min. at 324°F.; all others 30 min. at 307°F.

Recipe Materials	A9A-	A411A-						A109D-				
	35	1313	1444	1757	1758	1759	1760	71	72	73	74	75
Neoprene Type W	—	100.0	100.0	100.0	100.0	100.0	100.0	—	—	100.0	100.0	100.0
Neoprene Type WRT	—	—	—	—	—	—	—	100.0	—	—	—	—
Neoprene Type WHV	—	—	—	—	—	—	—	—	100.0	—	—	—
Neoprene Type GN	100.0	—	—	—	—	—	—	—	—	—	—	—
Magnesia	—	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	—	—	4.0
Zinc Oxide	—	5.0	5.0	15.0	15.0	15.0	200.0	5.0	5.0	—	—	5.0
Hi- Sil 233	—	—	—	—	—	—	—	25.0	—	—	—	—
Philblack A	—	—	—	—	—	—	—	15.0	—	—	—	—
Coray 230	—	—	—	—	—	—	—	5.0	—	—	—	—
Neozone A	1.0	—	—	—	—	—	—	2.0	2.0	—	—	—
Thionex	—	—	—	—	—	—	—	1.5	—	1.0	1.0	—
DOTG	—	—	—	—	—	—	—	.5	—	—	—	—
Sulfur	—	—	—	—	—	—	—	1.0	—	1.0	1.0	—
Indonex 637½	—	10.0	—	50.0	—	25.0	25.0	—	50.0	—	—	—
SRF Black	80.0	15.0	15.0	—	—	—	—	—	50.0	75.0	—	—
MT Black	—	—	—	100.0	100.0	100.0	50.0	—	150.0	—	—	—
NA-22	—	.75	.75	1.0	1.0	1.0	1.0	—	.5	—	—	.35
Circo LP Oil	20.0	—	—	—	—	—	—	—	—	10.0	—	—
Aranox	—	1.0	1.0	1.0	1.0	1.0	1.0	—	—	1.0	—	—
Akroflex CD	—	—	—	—	—	—	—	—	—	1.0	1.0	—
Stearic Acid	.5	—	—	—	—	—	—	—	—	.5	.5	—
Red Lead	20.0	—	—	—	—	—	—	—	—	20.0	20.0	—
Octamine	—	4.0	4.0	4.0	4.0	4.0	4.0	—	—	—	—	—
Atomite Whiting	—	50.0	50.0	—	—	—	—	—	—	—	—	—
Pliolite S6B	—	—	—	25.0	25.0	—	—	—	—	—	—	—
Kenflex N	—	—	—	—	50.0	—	—	—	—	—	—	—

does exhibit a different tensile strength trend. This could be attributed to the difference in types of neoprene polymers used and also to the fact that less antioxidant was used in A9A-35 while A109D-73 had a slightly different cure system. The other neoprene materials behaved very much in the same manner, the tensile strength differences being of degree rather than kind. In them the tensile strength was lowered with increased exposure until somewhere between 5 and 10 x 10^7 r, where it began to increase. These decreases and increases varied from moderate to extreme.

The two materials A109D-74 and A109D-75, whose tensile strength dropped extremely rapidly at early and intermediate doses, were gum type stocks without reinforcing loading. The cure system was different and A109D-74 contained more antioxidant. This probably explains in part why the tensile strength dropped more rapidly than in the other material, and why all the properties were severely affected. The filler loading evidently regulates the tensile strength behavior, as indicated by comparing A109D-74 with A109D-73 which contains a substantial amount of filler.

The compound A411A-1313 was the most resistant material evaluated and differed from A411A-1444 in that it contained ten parts of aromatic plasticizer. This is apparently the reason for its superiority. This same plasticizer is in compound A109D-72 in the amount of fifty parts, which probably explains why the tensile strength and hardness of this material changed very little until an exposure of 1 x 10^8 r. Thus, the aromatic plasticizer seems to have a stabilizing effect on the materials out to some point beyond which it loses its effectiveness in lessening induced radiation damage.

Compound A411A-1313 was also the best material in resistance to heat aging *(7)* which implies that radiation induced oxidation is one of the principal factors causing damage to the neoprene polymers. This is confirmed by other work *(7)* and by the fact that comparable materials containing more antioxidant or ones which were designed for heat resistance also fare better in a radiation field.

The drop in tensile strength typical of all the neoprene compounds suggests that chain cleavage is predominating at the particular exposures where this occurs. At the higher doses, where the tensile strength in most cases rises abruptly, cross-linking is apparently prevailing. None of the materials studied showed evidence of stress cracking at a dose of 1 x 10^7 r. The materials were not stapled nor otherwise stressed at higher exposures, and this fact therefore does not rule out the possibility that they are susceptible to stress cracking at some dose after 1 x 10^7 r.

Nitriles

Eighteen nitrile (acrylonitrile-butadiene copolymer) compounds were evaluated, six proprietary materials and twelve with known recipes. Accordingly this discussion is primarily based on the latter materials.

These compounds, like the preceding ones, show decreases in elongation and increases in hardness (which in a few instances is lowered slightly at first) with increasing exposure to radiation. The tensile strength again is noted to vary considerably and in general follows these trends: (1) continuous increase with increasing radiation exposure, (2) a slight increase fol-

TABLE II-D—RECIPES OF NITRILE ELASTOMERS USED FOR GAMMA RADIATION STUDIES

Compound AR cured 50 min. at 310°F.; all others 30 min. at 310°F.

Recipe Materials	1000x88-1	1000x88-2	1001	AR	1041	1002	1042	1042P	1072	1043	1014	1014-x11
Hycar 1000x88	100.0	100.0	—	—	—	—	—	—	—	—	—	—
Hycar 1001	—	—	100.0	100.0	—	—	—	—	—	—	—	—
Hycar 1041	—	—	—	—	100.0	—	—	—	—	—	—	—
Hycar 1002	—	—	—	—	—	100.0	—	—	—	—	—	—
Hycar 1042	—	—	—	—	—	—	100.0	100.0	—	—	—	—
Hycar 1072	—	—	—	—	—	—	—	—	100.0	—	—	—
Hycar 1043	—	—	—	—	—	—	—	—	—	100.0	—	—
Hycar 1014	—	—	—	—	—	—	—	—	—	—	100.0	—
Hycar 1014x11	—	—	—	—	—	—	—	—	—	—	—	100.0
Zinc Oxide	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
FEF Black	—	40.0	40.0	40.0	40.0	40.0	40.0	—	40.0	40.0	40.0	40.0
TMTD	3.0	3.5	3.5	3.5	3.5	3.5	3.5	—	3.5	3.5	3.5	3.5
Stearic Acid	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0
Antiox 4010	—	—	—	5.0	—	—	—	—	—	—	—	—
Durez 12687	—	—	—	—	—	—	—	50.0	—	—	—	—
Monex	—	—	—	—	—	—	—	.6	—	—	—	—
Sulfur	—	—	—	—	—	—	—	1.5	—	—	—	—
Thermax	100.0	—	—	—	—	—	—	—	—	—	—	—
BLE-25	1.5	—	—	—	—	—	—	—	—	—	—	—
GP-261	10.0	—	—	—	—	—	—	—	—	—	—	—

lowed by a decrease, and finally an increase, and (3) a continuous decrease until higher doses are reached where an abrupt increase takes place.

The tensile strength data indicate that both cross-linking and chain cleavage are occurring at low and intermediate exposures, chain cleavage predominating when the tensile strength is lowered, and cross-linking predominating when it increases. In a few cases this is confirmed by a lowering of the hardness. As the doses are increased the tensile strength increases and in very nearly every case this increase is very extreme, indicating that cross-linking is very much predominating.

The effect of the acrylonitrile content in the various Hycar compounds is not too pronounced, considering retention of both physical properties and flexibility. The various materials in order of decreasing acrylonitrile content are as follows: Very high, Hycar 1000x88; High, Hycar 1001 and Hycar 1041; Medium high, Hycar 1002, Hycar 1042 and Hycar 1072; Medium, Hycar 1043, and Low, Hycar 1014 and Hycar 1014x11. It will be noted from Table II-D that these materials differ only in the type of polymer used as the recipes are all the same. Hycar 1072 also has some carboxylic groups.

Probably the most significant effect the acrylonitrile content has on the radiation-induced changes is reflected in the tensile strength. The original tensile strength appears to be progressively lowered by radiation as the acrylonitrile content is reduced. For example, at a dose of 1 x 10^8 r, Hycar 1001 has lost 23.3 per cent of its tensile strength while Hycar 1043 has lost 49.8 per cent. There are some exceptions to this, such as Hycar 1014 which has lost only 23.1 per cent. However, this behavior should be considered a trend, and as stated previously, the acrylonitrile content does not appear to greatly affect the radiation resistance of the materials.

Although not as pronounced as the tensile strength, the hardness appears to be increased slightly with increasing radiation exposure as the acrylonitrile content is reduced. An examination of the data in Table III, which shows flexibility and minimum change in properties, very slightly favors the higher acrylonitrile content as being superior in radiation resistance.

Discussion of compounding ingredients must be restricted, as the studies were designed more to determine radiation effects of polymers rather than how the polymers were compounded. The limited data on the compounding ingredients show that the plasticizer and antioxidant used in compound 1000x88-1 appear to improve the radiation resistance of this material as compared with compound 1000x88-2. However, the 1000x88-1 has less curative, which probably could explain in part its better resistance. In this case the first doses of radiation would tend to further cure the material before actually beginning to damage it. The 1000x88-1 appears to be the second most resistant of the Hycars evaluated.

The addition of five parts of antioxidant (Antiox 4010) to Hycar 1001 is illustrated by compound Hycar AR, which is the most resistant of all the nitriles evaluated. It did not become stiff or brittle until a dose of 5 x 10^8 r had been reached. The selection of the type and amount of the antioxidant used is a result of previous work which had utilized certain materials as radiation inhibitors to lessen or retard the damaging effects of radiation. They have been called Anti-Rads *(8)*.

The addition of the phenolic resin and change in cure system incorporated in Hycar 1042 to produce the new material Hycar 1042-P improves the radiation resistance of the polymer slightly. The tensile strength shows increases with increasing exposure to radiation. The effect of antioxidants noted above in compounds 1000x88-1 and AR suggest that oxidation is a major, if not the major, mechanism which subsequently causes either cross-linking or chain cleavage. The antioxidants appear to act more efficiently at approximately 1 x 10^8 r and higher, where it is assumed that oxidation effects are becoming more pronounced. Other studies *(7)* indicate that oxidation is very pronounced after approximately 5 x 10^7 r.

Stress cracking was seen in many of the materials evaluated, as indicated in Table III. Some of the other materials, Hycar 1002 for example, were not stapled nor otherwise subjected to stress, which does not rule out the possibility that they are susceptible to stress cracking. It is interesting to note that compound 1072 did not stress crack at a dose of 3 x 10^8 r. This would indicate that the carboxylic groups are responsible for this. This compound also differs from others in its acrylonitrile content class with respect to tensile strength, which shows a steady increase with increasing exposure.

Styrene Rubbers

Five styrene (styrene-butadiene copolymer) rubber materials were investigated—three proprietary materials, and two whose recipes were known. Due to the limited number of materials in this class the discussion will include the three proprietary compounds. Discussion of PR 430-X24 and PR 430-X27 is limited, as tests comprised only a few doses because of the small number of these materials.

The tensile strength of the styrene rubbers follows three definite trends: (1) almost no change at all, as shown by PR 408-70, (2) a slight decrease followed by more decrease with increasing dose, as exemplified by HW-B10, and (3) a continuous increase, as shown by Hycar 2001. Hardness increases while elongation decreases with continued exposure. All three physical properties are very little affected out to an exposure of 1 x 10^7 r. After this dose, the property changes increase more rapidly.

Considering the two extreme cases of tensile strength behavior as shown in Hycar 2001 (increasing) and HW-B10 (decreasing), it is difficult to determine whether or not cross-linking is predominating at any given time. If the materials were being oxidized it would probably follow that Hycar 2001 is being oxidized less, as the work on the previous classes of materials tends to indicate that increases in tensile strength can be expected in materials which do not readily oxidize. The Hypalons exhibit this characteristic. Further discussion on mechanisms of damage and effect of compounding materials is restricted because of the limited number of materials examined.

Of the materials in this class, PR 408-70 was the most resistant to the effects of radiation, not becoming stiff and brittle until a dose of 1 x 10^9 r was reached. However, it failed the 180-degree bend test after a dose of 5 x 10^8 r. All of the materials tested show evidence of stress cracking at doses of 5 x 10^7 r and higher.

Of the four physical properties investigated, elongation appears to be the most consistent, as it always decreases with increasing radiation exposure. It therefore offers a good index of the state of the material at any particular radiation exposure. Hardness offers the same advantages but to a more limited degree, because in many instances the rates of change as well as magnitude of change do not vary as rapidly with increasing radiation exposure. Flexibility appears to be most useful at the higher doses when the material is beginning to become stiff and approaching brittleness.

The tensile strength, because of its great variations within classes of like materials, is probably the poorest index of the condition of the material. This is best illustrated by examining the tensile strength of PR 408-70 styrene elastomer. For example, using the tensile strength alone, this material appears to be undamaged at a dose of 1 x 10^9 r, where it had only increased 1.8 per cent, which is not within the accuracy of the tensile strength measurements. As was stated in the previous article *(2)*, it is necessary to take as many properties into account as possible to best study the behavior of and effects on materials exposed to radiation. This is particularly true for applications which do not require that all property changes to be held to a minimum. For example, a substantial loss in elongation will not affect the operation of some types of seals.

TABLE II-E—RECIPES OF STYRENE ELASTOMERS USED FOR GAMMA RADIATION STUDIES

Cures: 30 min. at 307°F.

Recipe Materials	Hycar 2001	HW-B10
Hycar 2001	100.0	—
GR-S 1500	—	100.0
Zinc Oxide	5.0	5.0
Sulfur	1.5	—
SRF Black	60.0	25.0
MPC Black	—	25.0
Stearic Acid	1.0	—
Circo Light Oil	7.0	—
Monex	.5	—
Agerite Resin D	—	2.0
Methyl Tuads	—	3.0
Altax	—	.5

Summary

Physical property changes of a great many materials classified as acrylics, chlorosulfonated polyethylenes, chloroprenes, nitriles and styrene rubbers as a result of exposure to gamma radiation have been discussed. All materials were exposed to doses from 1 to 10 x 10^8 r depending upon their resistance to the damaging changes induced. Each material, because of space limitations, could not be treated individually and the reader is urged to make his own comparisons or examinations of those materials in which he has an interest.

Of the five general classes of materials studied, the styrene-butadiene copolymers appear to be the most resistant to the damaging effects of radiation, and the acrylics are rated second. The remaining three groups appear to be about equal and are very close to the second-ranked acrylics. It should be noted that because of the overlapping of materials in one class with materials in another class, the above order should be considered very general. Also, a consideration of other environments could obviously alter the order of the above listing.

From the data presented it is difficult to assign permissible dose limits for classes of materials or even individual materials. This is in part due to the overlapping of radiation resistance between classes and within a class and in part to the fact that the demands of a particular application, such as the environmental requirements and essential properties needed, must be

Table III—Effects of Gamma Radiation on Physical Properties of Elastomers

Materials	Dose (r x 10^6)	Initial Properties and Per Cent Change: Hardness Shore A; Δ%	Elongation %; Δ%	Tensile psi; Δ%	Remarks
ACRYLICS					
Acrylon BA-12	0	79	225	1590	Black
	5	1.3	— 21.5	9.9	
	10	1.3	— 32.7	— 8.2	
	50	7.8	— 66.4	— 15.8	
	100	12.5	— 77.6	— 7.6	
	150	15.6	— 86.5	— 3.1	
	300	19.0	— 86.5	2.6	a
	500	21.5	— 86.5	44.9	a
	1000	26.6	— 98.2	20.1	a
Acrylon EA-5	0	70	545	1580	Black
	5	0.0	— 9.9	8.0	
	10	0.0	— 32.0	5.1	
	50	8.6	— 68.9	4.4	
	100	14.3	— 85.3	— 10.2	
	150	20.0	— 87.2	— 7.6	
	300	28.6	— 87.2	16.1	a
	500	34.3	— 90.8	38.6	a
	1000	40.0	— 97.7	32.1	a
Vyram	0	68	275	970	Black
	5	8.8	— 23.4	28.2	
	10	10.2	— 28.8	28.9	
	50	27.9	— 87.2	— 3.0	a
	100	38.2	— 87.2	7.1	a
	150	38.7	— 92.7	15.6	a
PR 1203-70	0	70	505	1345	Black
	5	1.4	— 13.7	10.0	
	10	1.4	— 26.6	12.0	
	50	12.9	— 84.1	9.2	b
	100	20.0	— 90.1	8.1	a,b
	300	31.4	— 90.1	— 7.7	a
Hycar 4021	0	64	390	1785	Black
	3	— 3.1	— 12.4	— 13.6	
	6	— 3.1	— 25.3	— 15.8	
	30	3.1	— 66.5	— 61.8	
	60	9.4	— 75.5	— 64.0	
	90	12.4	— 80.7	— 54.8	
	300	31.8	— 89.6	— 18.0	a
Hycar 2121x26-1	0	77	410	1840	Black
	5	5.2	— 26.8	13.8	
	10	5.2	— 37.8	16.5	
	50	11.7	— 74.4	10.4	
	100	15.6	— 86.6	0.5	
	150	18.2	— 91.5	— 6.4	a
	300	23.4	— 92.7	6.3	a
Hycar 2121x26-2	0	79	260	1810	Black
	5	2.5	— 16.0	9.1	
	10	2.5	— 35.1	3.2	
	50	10.1	— 69.5	0.0	
	100	13.9	— 77.1	6.6	
	150	15.2	— 86.6	— 1.2	a
	300	21.5	— 90.5	6.9	a
Hycar 2121x26-3	0	77	355	1685	Black
	5	3.9	— 29.2	16.6	
	10	3.9	— 41.9	11.4	
	50	11.7	— 73.1	16.3	
	100	15.6	— 81.6	10.9	
	150	19.5	— 91.5	— 4.8	a
	300	24.7	— 92.9	5.9	a
Hycar 2121x26-4	0	81	240	1830	Black
	5	2.5	— 9.1	2.2	
Hycar 2121x26-4 *(Cont'd.)*	10	2.5	— 21.5	— 4.0	
	50	8.6	— 58.7	— 1.7	
	100	9.9	— 73.1	7.9	
	150	14.8	— 83.5	— 4.6	
	300	18.5	— 83.5	27.1	a
Hycar 2121x27-1	0	74	155	1520	Black
	5	4.1	— 19.4	— 6.6	
	10	5.4	— 29.0	— 12.3	
	50	13.6	— 61.3	— 9.6	
	100	20.3	— 80.6	— 12.9	a
	150	23.0	— 87.1	— 11.4	a
	300	29.7	— 90.3	0.6	a
Hycar 2121x27-2	0	70	310	1625	Black
	5	4.3	— 25.6	— 2.9	
	10	4.3	— 32.0	— 5.6	
	50	17.1	— 75.7	— 11.3	
	100	22.9	— 85.4	— 16.6	a
	150	27.1	— 91.9	— 24.3	a
	300	37.1	— 95.1	— 11.7	a
Hycar 2121x27-3	0	68	375	1490	Black
	5	4.4	— 28.0	16.8	
	10	8.8	— 45.1	7.9	
	50	22.1	— 57.3	— 20.2	
	100	30.9	— 90.7	— 16.2	a
	150	33.4	— 93.3	— 17.2	a
	300	39.7	— 94.7	1.5	a
Hycar 2121x27-4	0	74	145	1420	Black
	5	2.7	— 13.2	4.4	
	10	4.1	— 20.1	— 5.4	
	50	13.6	— 65.3	— 15.2	
	100	17.6	— 68.8	— 3.2	
	150	23.0	— 82.6	0.0	
	300	27.0	— 86.1	10.8	a
CHLOROSULFONATED POLYETHYLENES					
Hypalon S-2	0	76	265	1160	Black
	3	— 3.9	1.9	38.4	
	6	— 6.6	— 5.7	20.3	
	30	— 2.6	— 35.9	32.5	
	60	9.2	— 52.8	20.3	
	90	11.8	— 60.4	20.3	
A2411A-277	0	81	245	2790	Black
	5	1.2	— 14.6	13.8	
	10	1.2	— 39.2	8.5	
	50	6.2	— 55.3	— 15.9	
	100	14.8	— 79.7	— 11.2	
	150	19.8	— 86.8	14.5	a
	300	23.5	—100.0	32.3	a
A2411A-391	0	71	410	1940	Black
	5	2.9	— 7.9	1.7	
	10	5.6	— 28.0	— 2.3	
	50	11.3	— 51.2	— 6.5	
	100	23.9	— 80.5	— 9.5	
	150	31.0	— 90.2	— 14.7	a
A2109D-3	0	78	295	2680	Black
	5	1.3	— 21.8	8.1	
	10	2.6	— 30.3	9.5	
	50	6.4	— 50.7	— 13.5	
	100	17.9	— 81.3	— 2.6	
	150	23.1	— 86.4	10.3	a

*Exceeded capacity of tensile tester; tensile strength greater than 4000 psi. **Did not break; elongation greater than 900%. ***Exceeded capacity of tensile tester; tensile strength greater than 7000 psi (two tensile testers with different capacities were used). a = broke when subjected to 180-degree bend test; b= slightly tacky; c = yellow-brown in color; d = light brown in color; e = olive drab in color; f = stress cracks first observed at this dose; g = Durometer C scale used for hardness measurements.

TABLE III—EFFECTS OF GAMMA RADIATION ON PHYSICAL PROPERTIES OF ELASTOMERS *(Cont'd.)*

Materials	Dose (r x 10^6)	Hardness Shore A; Δ%	Elongation %; Δ%	Tensile psi; Δ%	Remarks
CHLOROSULFONATED POLYETHYLENES (Cont'd.)					
HW-B7	0	76	500	1930	Black
	3	5.3	— 16.7	26.1	
	10	5.3	— 26.3	29.8	
	50	14.5	— 72.1	18.5	
	100	23.7	— 87.1	24.5	
	150	26.3	— 90.0	21.5	a
HW-B8	0	75	440	1840	Olive
	5	2.7	— 5.4	13.5	
	10	2.7	— 9.5	5.3	
	50	10.7	— 44.6	8.9	
	100	20.0	— 72.9	0.3	
	150	22.7	— 80.2	11.0	
	300	30.7	— 92.1	60.7	a
HW-B9	0	82	275	3110	Black
	5	1.2	— 18.5	9.0	
	10	3.7	— 20.3	10.6	
	50	6.1	— 56.5	9.4	
	100	12.2	— 72.8	8.6	
	150	13.4	— 80.1	19.6	
	300	20.7	— 92.8	*	a
PR 1401-70	0	75	225	1800	Black
	5	4.0	— 22.9	33.7	
	10	6.7	— 36.1	42.4	
	50	17.3	— 73.6	35.6	
	100	21.3	— 78.0	45.7	
	300	33.3	— 91.2	82.9	a
CHLOROPRENES					
M-3854	0	56	785	1105	Black
	3	0.0	**	**	
	6	0.0	**	**	
	30	0.0	— 25.3	— 6.2	
	60	10.7	— 55.9	— 31.9	
	90	25.0	— 79.6	— 42.8	
M-3871	0	75	490	1380	Black
	3	0.0	— 15.3	2.7	
	6	1.3	— 38.8	10.2	
	30	1.3	— 48.3	— 5.6	
	60	6.7	— 59.2	— 19.1	
	90	13.8	— 80.6	5.9	
PR 227-70	0	72	290	2675	Black
	5	1.4	— 8.0	1.8	
	10	2.8	— 13.2	7.1	
	50	15.3	— 67.0	— 9.3	
	100	29.2	— 79.2	— 10.4	a
A9A-35	0	78	385	1970	Black
	3	— 3.8	— 16.9	11.2	
	6	1.4	— 19.5	14.9	
	30	1.4	— 43.9	10.0	
	60	6.4	— 75.2	— 10.9	
	90	14.1	— 80.4	— 19.3	
A411A-1313	0	64	635	2120	Black
	5	1.6	— 4.1	— 1.1	
	10	4.7	— 15.9	— 9.6	
	50	14.1	— 60.7	— 51.2	
	100	28.1	— 80.3	— 55.1	
	150	40.6	— 89.8	— 32.2	
	300	66.7	— 92.2	39.8	a
CHLOROPRENES (Cont'd.)					
A-411A-1444	0	65	580	2290	Black
	5	9.2	— 11.5	— 5.3	
	10	10.7	— 21.8	— 9.3	
	50	21.5	— 65.6	— 49.3	
	100	33.8	— 82.0	— 42.0	
	150	46.2	— 91.4	— 33.5	
A411A-1757	0	72	505	1710	Black
	5	1.4	— 5.3	2.5	
	10	1.4	— 16.2	— 0.6	
	50	13.9	— 59.4	— 15.5	
	100	23.6	— 74.4	— 9.3	
	300	37.5	— 95.1	29.3	a
A411A-1758	0	69	485	1770	Black
	5	2.9	— 7.6	2.0	
	10	2.9	— 16.8	1.7	
	50	15.9	— 54.8	— 1.4	
	100	26.1	— 73.3	— 7.1	
	300	42.0	— 93.8	50.3	a
A411A-1759	0	68	415	1820	Black
	5	— 1.5	— 12.8	0.7	
	10	0.0	— 20.1	— 4.5	
	50	14.7	— 61.3	— 11.2	
	100	30.1	— 77.0	1.7	
	300	47.1	— 97.6	97.4	a
A411A-1760	0	74	515	1460	Black
	5	1.4	— 10.7	1.6	
	10	5.4	— 18.4	— 0.6	
	50	18.9	— 71.8	— 10.4	
	100	29.7	— 84.5	26.3	a
A109D-71	0	67	660	3125	Black
	5	13.4	— 10.6	— 1.5	
	10	16.4	— 22.0	— 3.5	
	50	23.9	— 58.3	— 26.7	
	100	35.8	— 68.9	— 28.4	
	150	44.8	— 93.9	— 18.3	a
A109D-72	0	77	245	1905	Black
	5	1.3	— 5.7	— 3.0	
	10	6.5	— 20.1	— 2.1	
	50	9.1	— 42.6	— 0.6	
	100	14.4	— 67.2	— 2.1	
	150	23.4	— 83.6	32.8	a
A109D-73	0	77	255	2970	Black
	5	3.9	— 6.3	— 2.2	
	10	7.8	— 21.9	— 3.5	
	50	13.0	— 49.2	— 11.7	
	100	20.8	— 78.5	— 6.7	
	150	26.0	— 88.3	9.7	a
A109D-74	0	56	730	2195	Brown
	5	10.7	— 16.7	— 2.5	
	10	12.5	— 43.6	— 59.4	
	50	25.0	— 82.2	— 80.6	
	100	48.2	— 96.9	— 81.9	a
	150	69.6	— 96.9	— 25.6	a
A109D-75	0	68	825	3065	Cream
	5	2.6	— 47.5	— 65.0	
	10	7.4	— 83.7	— 83.2	
	50	14.7	— 95.2	— 89.9	a,c
	100	35.3	— 97.0	— 75.7	a,d
	150	44.1	— 97.0	— 37.9	a,e

*Exceeded capacity of tensile tester; tensile strength greater than 4000 psi. **Did not break; elongation greater than 900%. ***Exceeded capacity of tensile tester; tensile strength greater than 7000 psi (two tensile testers with different capacities were used). a = broke when subjected to 180-degree bend test; b = slightly tacky; c = yellow-brown in color; d = light brown in color; e = olive drab in color; f = stress cracks first observed at this dose; g = Durometer C scale used for hardness measurements.

TABLE III—EFFECTS OF GAMMA RADIATION ON PHYSICAL PROPERTIES OF ELASTOMERS *(Cont'd.)*

Materials	Dose (r x 10^6)	Initial Properties and Per Cent Change — Hardness Shore A; Δ%	Elongation %; Δ%	Tensile psi; Δ%	Remarks
		NITRILES			
PR 122-70	0	75	255	2075	Black
	3	1.3	— 5.5	0.0	
	6	1.3	— 7.5	6.1	
	30	1.3	— 21.3	6.6	
	60	2.8	— 39.0	— 13.3	
	90	5.3	— 54.7	— 15.1	
	180	14.7	— 70.5	— 10.4	
	300	32.9	— 91.9	58.3	a
PR 142-70	0	71	410	1335	Black
	3	— 2.8	— 9.3	6.7	
	6	— 2.8	— 13.0	3.4	
	30	0.0	— 47.3	7.7	
	60	5.6	— 59.6	1.6	
	90	14.1	— 71.8	6.6	
	180	19.7	— 86.5	3.9	
	300	41.2	— 94.0	67.2	a
46-101	0	72	500	2460	Black
	3	1.4	— 14.7	6.1	
	6	2.8	— 16.7	— 4.9	
	30	2.8	— 47.8	— 14.6	
	60	9.3	— 69.9	— 21.9	
	90	16.7	— 75.9	— 15.1	
1063-16	0	66	455	2630	Black
	6	0.0	— 21.8	2.8	
	90	22.7	— 76.9	— 50.0	
7505-70	0	76	315	2295	Black
	5	1.3	— 4.5	5.6	
	10	5.3	— 18.8	9.4	f
	50	14.5	— 56.1	24.4	
	100	18.4	— 73.6	32.9	
	300	29.0	— 90.5	53.3	a
7513-80	0	82	225	2470	Black
	5	3.7	— 11.1	10.9	
	10	3.7	— 13.3	11.8	f
	50	12.2	— 55.6	34.3	
	100	15.9	— 77.8	55.6	
	300	22.0	—100.0	*	a
Hycar 1000x88-1	0	65	770	1650	Black
	5	3.1	— 9.1	0.4	
	10	6.2	— 15.6	1.5	
	50	20.0	— 55.8	8.5	f
	100	33.6	— 81.8	32.5	
	150	35.4	— 87.7	29.9	
	300	46.2	— 96.1	35.6	a
Hycar 1000x88-2	0	75	545	3630	Black
	5	— 1.3	— 4.0	0.0	
	10	4.0	— 15.0	— 2.6	
	50	14.7	— 77.1	— 8.9	
	100	26.7	— 87.2	— 17.1	
	300	33.3	— 98.2	*	a
Hycar 1001	0	75	520	3460	Black
	3	— 1.3	— 8.6	3.2	
	5	— 2.7	— 16.9	5.1	
	6	— 4.0	— 23.0	— 0.1	
	30	1.3	— 56.7	— 14.4	
	50	8.0	— 66.6	— 27.8	f
	100	20.0	— 84.6	— 23.4	
	300	38.9	— 98.1	*	a
Hycar AR	0	68	565	3210	Black
	5	5.9	— 5.7	2.2	
	10	5.9	— 8.7	4.1	
	50	11.8	— 45.0	— 4.2	f
	100	19.1	— 68.1	— 1.4	
	150	25.0	— 73.4	— 1.7	
	300	36.8	— 87.9	7.9	
	500	47.1	— 98.2	*	a
Hycar 1041	0	72	555	3170	Black
	5	1.4	— 7.4	6.0	
	10	4.2	— 26.3	4.9	
	50	19.4	— 79.3	— 5.6	
	100	25.0	— 86.5	— 6.8	
	150	31.9	— 87.4	24.9	a
Hycar 1002	0	71	435	3005	Black
	3	— 2.8	2.1	11.5	
	6	1.4	— 7.1	8.6	
	30	7.0	— 34.6	— 35.1	
	60	15.5	— 71.3	— 38.4	
	90	23.9	— 78.2	— 32.9	
	300	35.1	— 95.5	*	a
Hycar 1042	0	68	575	2985	Black
	5	2.9	— 10.5	5.1	
	10	7.4	— 23.6	— 1.9	
	59	20.6	— 74.8	— 15.9	
	100	22.1	— 78.3	— 6.4	
	300	47.1	—100.0	*	a
Hycar 1042-P	0	75	475	3140	Brown,g
	5	1.3	— 11.8	2.5	
	10	2.7	— 21.1	6.8	
	50	8.0	— 52.5	22.6	
	100	10.7	— 72.6	13.3	
	300	26.7	— 95.8	78.2	a
	500	28.0	—100.0	80.2	a
Hycar 1072	0	81	380	3630	Black
	5	7.4	— 15.8	7.5	
	10	11.1	— 31.6	13.4	
	50	17.3	— 67.1	23.6	
	100	23.5	— 89.5	29.2	
	300	23.5	—100.0	***	a
Hycar 1043	0	68	470	2685	Black
	5	5.9	— 12.7	7.3	
	10	5.9	— 16.3	— 0.5	
	50	17.7	— 68.2	— 33.3	
	100	32.4	— 88.4	— 49.8	f
	150	35.3	— 91.5	— 18.5	a
	300	47.0	— 96.8	139.5	a
Hycar 1014	0	70	355	2230	Black
	5	0.0	— 1.1	13.1	
	10	2.7	— 2.5	17.3	
	50	17.4	— 61.7	— 14.5	
	100	28.6	— 78.8	— 23.1	f
	150	31.4	— 88.7	45.5	a
	300	42.8	—100.0	72.8	a
Hycar 1014x11	0	69	400	2485	Black
	5	1.5	— 10.2	— 0.1	
	10	7.3	— 19.0	— 4.5	
	52	26.1	— 71.3	— 16.4	
	100	31.8	— 80.1	— 18.2	
	300	44.9	—100.0	67.4	a

*Exceeded capacity of tensile tester; tensile strength greater than 4000 psi. **Did not break; elongation greater than 900%. ***Exceeded capacity of tensile tester; tensile strength greater than 7000 psi (two tensile testers with different capacities were used). a = broke when subjected to 180-degree bend test; b = slightly tacky; c = yellow-brown in color; d = light brown in color; e = olive drab in color; f = stress cracks first observed at this dose; g = Durometer C scale used for hardness measurements.

TABLE III—EFFECTS OF GAMMA RADIATION ON PHYSICAL PROPERTIES OF ELASTOMERS *(Cont'd.)*

Materials	Dose (r x 10^6)	Initial Properties and Per Cent Change: Hardness Shore A; Δ%	Elongation %; Δ%	Tensile psi; Δ%	Remarks
STYRENE ELASTOMERS					
PR 408-70	0	73	355	2075	Black
	5	0.0	0.0	5.0	
	10	0.0	— 1.7	3.3	
	50	9.6	— 31.2	2.0	f
	100	13.7	— 57.8	— 4.2	
	300	21.9	— 84.8	— 0.5	
	500	35.2	— 90.7	1.5	a
	1000	40.8	—100.0	1.8	a
PR 430-X24	0	77	215	1870	Black
	5	2.6	5.6	4.0	
	50	16.9	— 55.8	3.6	f
	100	24.7	— 88.4	— 27.2	a
	300	29.9	—100.0	*	a
PR 430-X27	0	72	290	2420	Black
	50	12.5	— 41.4	16.5	f
	100	16.7	— 44.8	25.1	
	300	25.8	— 70.3	33.7	a
(Cont'd.)	500	38.9	— 93.1	36.0	a
Hycar 2001	0	69	435	2155	Black
	5	5.8	— 16.7	3.2	
	10	10.1	— 17.4	11.5	
	50	18.8	— 73.6	13.3	f
	100	29.0	— 81.7	13.3	
	300	43.5	— 93.1	16.3	a
	500	44.9	—100.0	31.3	a
HW-B10	0	66	720	2905	Black
	5	1.5	— 5.6	0.9	
	10	3.0	— 6.9	— 2.1	
	50	9.1	— 38.9	— 33.9	
	100	21.2	— 72.2	— 31.6	f
	300	33.3	— 91.3	— 40.5	
	500	42.4	— 97.9	— 61.5	a

*Exceeded capacity of tensile tester; tensile strength greater than 4000 psi. **Did not break; elongation greater than 900%. ***Exceeded capacity of tensile tester; tensile strength greater than 7000 psi (two tensile testers with different capacities were used). a = broke when subjected to 180-degree bend test; b = slightly tacky; c = yellow-brown in color; d = light brown in color; e = olive drab in color; f = stress cracks first observed at this dose; g = Durometer C scale used for hardness measurements.

known in advance. Each material or class, then, must be considered on its own merits and intended application.

Radiation damage or changes induced in the physical properties of the various elastomers studied is the result of the over-all or net effect of cross-linking or chain cleavage, which can occur either at the same time or separately. This radiation induced damage changes the base polymer material, but can be retarded or inhibited to varying degrees by the manner in which the polymers are compounded. For example, some antioxidants assist in reducing the extent of radiation damage, particularly in those materials in which radiation accelerates oxidation or ozonation which can cause either cross-linking or chain cleavage.

Certain plasticizers, usually of an aromatic type, appear to protect the base polymer. Heat-resistant materials are superior in a radiation field only when both their radiation and thermal damage are primarily caused by oxidation. They are basically designed and fortified to resist the damaging effects of oxidation. The radiation resistance of an elastomer appears to be determined by two factors: one, the inherent resistance of the polymer itself, and two, the manner in which it is compounded.

In general, the elongation of elastomers always decreases with increasing exposure to radiation while the hardness increases. The tensile strength, on the other hand, is much less predictable, and will exhibit many trends. All materials, if given sufficiently high doses of radiation will become stiff and brittle. It should be noted that these statements concerning properties refer only to the materials discussed in this article. Materials which primarily undergo chain scission, which will be analyzed in a future article, behave quite differently.

It is necessary to obtain the physical property changes at many different exposures in order to best study materials. For example, at a dose of 5 x 10^5 r one material may appear better than another, but at a dose of 1 x 10^6 r the reverse could very well be true.

ACKNOWLEDGEMENT

Acknowledgement is made to the various suppliers of materials for their cooperation in submitting test samples and pertinent materials information. It should be noted that many of the materials evaluated might never have been developed or intended by the manufacturers for the conditions to which they have been subjected. Any failure or poor performance of a material is not necessarily indicative of the utility of the material under less stringent conditions or for other applications.

Acknowledgement is also made to D. L. Hunke of the Phillips Petroleum Co., Idaho Falls, Idaho, operators of the Materials Testing Reactor for the A.E.C., and to S. W. Smith and F. M. Newby of the Hanford Atomic Products Operation, General Electric Co., for their assistance and cooperation in carrying out the irradiations.

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Compounds for High Temperature Fuel Seals

Results of tests of various polymers
Design and operation of a testing machine

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SINCE the properties of elastomer compounds at high temperatures while immersed in aircraft fuels were of particular interest in this study, initial efforts were made to locate a suitable testing device. As this search was unfruitful, the designing of a special testing machine was initiated. After much literature research and after many preliminary designs had been considered, the use of a hydraulic system to determine the stress applied to the experimental specimen survived as a practical method of testing. The selection of a test specimen of constant cross section, an O-ring, permitted the mechanical determination of strain.

The final machine design incorporated a fixed metal bellows filled with hydraulic fluid as the unit in which the pressure would reflect the stress applied to the O-ring. The O-ring was mounted between a spindle attached to the metal bellows and on a second spindle attached to a moving metal rod. The spindles were fabricated of Teflon and were made free to rotate so as to eliminate unequal stress distribution which might be encountered if the O-ring became bound on fixed spindles.

A schematic diagram of this system is presented in Figure 1. It can be seen that upward movement of the metal rod elongates the test O-ring and exerts a force on the metal bellows. This force is reflected as a decrease in the pressure of the hydraulic fluid within the metal bellows. The machine itself is seen in Figure 2.

The fuel pressure, P_1, and the pressure within the metal bellows, P_2, can be raised by the addition of pres-

Note: This paper was presented before the conference on "Elastomers for Air Weapons" sponsored by Wright Air Development Center and the University of Dayton, in Dayton, Ohio, March 27, 1957.

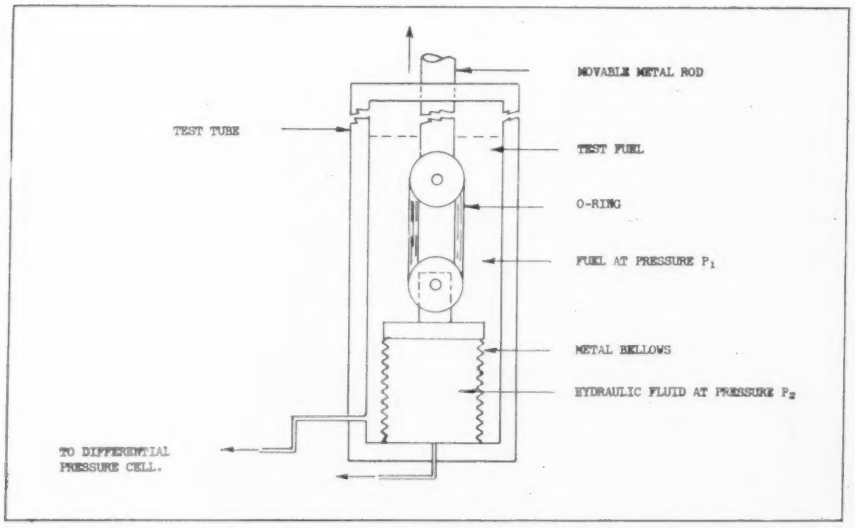


FIG. 1—Schematic diagram of the Type I Tester designed for testing of elastomer compounds at high temperatures while immersed in aircraft fuels.

surized nitrogen and of additional hydraulic fluid, respectively. These pressures are equalized prior to each test so that the strain on the O-ring is measured as the pressure differential of the fuel and the fluid within the bellows.

The reason for the need for additional pressurization, particularly in the case of fuels of low vapor pressure, becomes obvious. The application of stress to the O-ring manifests itself as a reduction in the pressure within the metal bellows, and hence an increase in the differential pressure of the test tube and the bellows. The upper limit of this measured differential pressure then becomes the intial pressure within the test tube.

These considerations, which lead to a certain minimum pressure within the test tube for each O-ring specimen, are as follows:

$$P = P_1 - P_2 \qquad (1)$$

where P = measured differential pressure,
P_1 = fuel pressure (+ nitrogen)
P_2 = hydraulic fluid pressure.

$$P_{(MIN)} = \frac{F}{A} \qquad (2)$$

where P_{MIN} = minimum differential pressure,
F = maximum force applied to O-ring, and
A = cross sectional area of O-ring.

The maximum force, F, of Equation 2, would be dependent on the tensile strength and cross-sectional area of the O-ring being tested. This force in turn determines the minimum differential pressure necessary for rupture of the O-ring. If the pressure within the metal bellows reached zero at the time of rupture of the O-ring, then the minimum differential pressure of the system would be the initial pressure in the test tube. Actually, some pressure above this anticipated minimum is used.

As the metal bellows is itself a metal spring, a differential pressure cell with very low displacement is a necessity as liquid displacement from the bellows would allow the metal bellows to exert force on the O-ring specimen and hence introduce an error in the relation between measured differential pressure and actual stress applied to the O-ring. Calibration of the instrument using a standard extension spring has exhibited a maximum error of 1.5 per cent. This maximum deviation was encountered at a differential pressure of 90 psi—which is roughly equivalent to a tensile strength of 3500 psi for an O-ring of ⅛-inch diameter.

Dioctyl phthalate is used as the fluid within the metal bellows, but the manufacturer's recommendations indicated the use of a silicone oil within the differential pressure transducer. These liquids are separated by a flexible diaphragm.

Components of the Tester

Test Tubes. An assembled test tube and its various components are illustrated in Figure 3. Although the tubes are capable of withstanding pressures of 1000 psi, work to date has used pressures during aging corresponding to the vapor pressure of the various media at the temperature of aging.

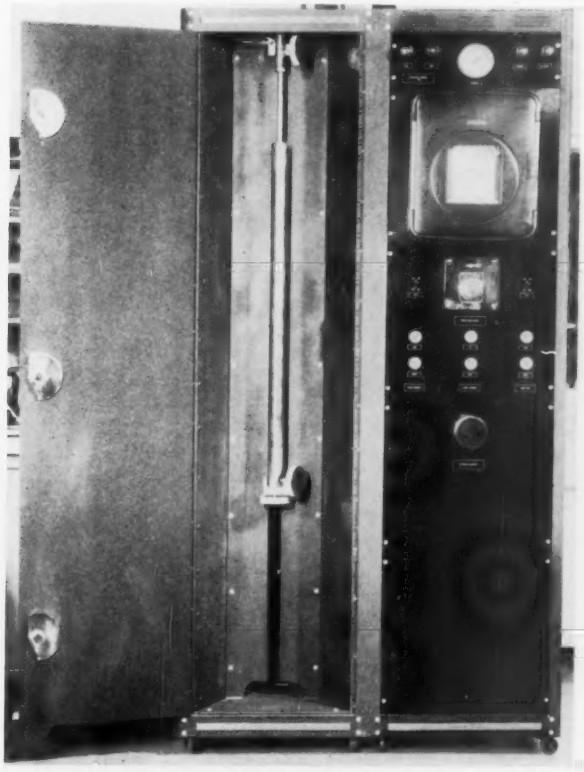


FIG. 2—Type I Tester.

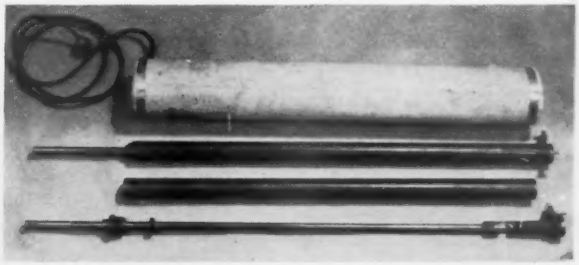


FIG. 3—Test tube for Type I Tester, assembled and disassembled. The test tube heater is seen at the top.

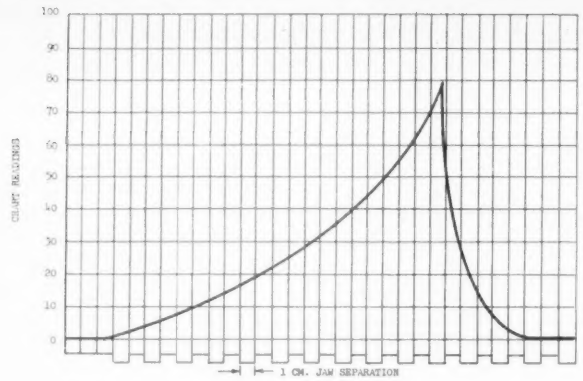


FIG. 4—Example of the permanent record obtained for each test specimen by the recording unit.

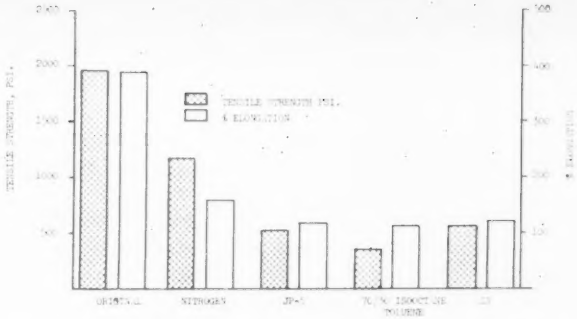


FIG. 5—Comparison of original properties of a nitrile rubber stock with properties at 325°F. in various media after aging for 72 hours and in air after aging for 24 hours.

Tube Heaters. The heat aging of the O-ring samples is conducted by placing the test tubes in thermostated jacket heaters. These heaters consist of a 2 inch thin wall tube electrically insulated with asbestos paper and wound uniformly with a 250 watt ribbon heating element. A thermostat is in direct contact with the inner metal tube and the assembly is heat insulated with magnesia pipe covering. When checked with a thermometer placed in the jacket cavity, a variation of less than 2°F. was found. A tube heater is shown at the top of Figure 3.

Recording Unit. The recording unit is activated by a signal from the strain gage element and hence records the stress applied to the O-ring. An auxiliary marking pen is activated by a switch which is opened and closed by the operation of a geared rack and pinion assembly connected to the moving member of the test tube. Reference marks are recorded at intervals of one centimeter. An example of this permanent record obtained with each test specimen is illustrated in Figure 4. The curve indicates the load applied to the O-ring, and each saw tooth pattern at the bottom of the record indicates a one centimeter displacement of the spindles holding the O-ring.

Pulling Unit. Movement of the metal rod of the tube, seen in Figure 2, is accomplished by clamping the rod to the piston of a hydraulic pump and cylinder assembly. By the use of a pressure compensated valve in the pulling assembly, rates of 2 to 40 inches per minute which are independent of the load can be dial selected. In the work discussed in this paper, a speed of 20 inches per minute was used in all tests.

Operation and Limitations of the Tester

After the O-ring sample has been heat aged for a designated time and temperature, the test tube is removed from the tube heater and clamped to jaws of the tester. The lower jaw is fixed and the upper jaw receives the moving metal rod of the test tube and pulls it upward.

The connections to the differential pressure cell are made, and the valves are opened. The pressure within the fuel cell is then indicated on the small upper dial. This pressure is raised to about 90 psi by the addition of nitrogen. Additional dioctyl phthalate is introduced into the bellows of the test tube until the pressures are equal and the recorder reads zero.

The hydraulic pump is then started. This also activates the chart drive of the recorder. The entire time required to perform a typical test is about five minutes.

The test tubes incorporate O-rings; hence aging conditions in the test tubes are limited by the performance of the O-rings. As the aim of this program is to develop superior materials for use as fuel seals, it would appear that the engineering employed followed the boot strap principle. But for periods of aging beyond the capability of the O-rings the specimens are aged for almost all of the aging period in sealed glass tubes and are then transferred to the metal test tubes, and aged under the same condition for a few hours prior to physical testing. The O-rings of the test tubes are replaced after each test.

With the present design, some reduction of temperature is encountered in transferring the tubes from the heaters to the tester. For tests at 325°F., about a 15° drop is encountered, while for tests at 400°F., a drop of about 30°F. occurs. Modifications are now under way to eliminate this cooling.

A further limitation is the number of specimens that can be tested, as each test of a single O-ring necessitates a complete test tube assembly.

The Type I Tester was designed as an interim apparatus and construction of two other machines is now un-

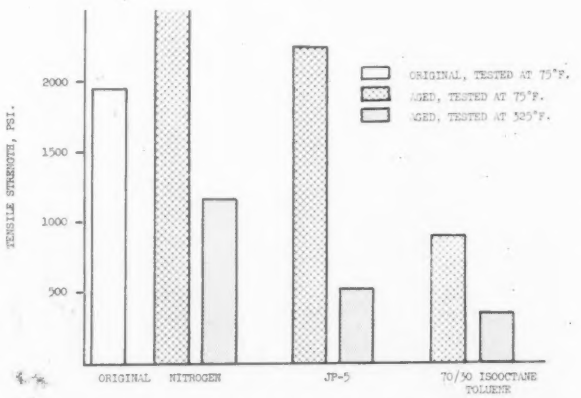


FIG. 6—Comparison of tensile strengths of a nitrile rubber stock after aging for 72 hours at 325°F. while still in the aging media and at 75°F. after removal from the aging media.

der way. Both are designed to eliminate the problem of cooling during testing.

The Type II Tester will allow as many as 30 O-rings to be aged and tested in a common fuel in one batch. No sliding shaft seals are involved in the design.

The third apparatus, the Micro Tester, is designed to occupy about two feet of front space of a conventional laboratory hood. Measuring and recording equipment will be located at some point outside of the hood. This design is unique in that stress is applied to the sample magnetically rather than mechanically and hence eliminates any sliding or rotating seals. Only static metal-to-metal or metal-to-Teflon seals are involved. A preliminary mock-up of this apparatus exhibited forces corresponding to elastomer tensile strengths of 5000 psi. At 400°F. it is felt that this will be sufficient for at least the near future.

Data Obtained with the Type I Tester

The requirement of high temperature stability eliminates many elastomers from consideration, and the requirement of fuel resistance eliminates still more. A combination of these requirements almost decimates the field. Hence this investigation is limited to relatively few elastomers.

Early work to become familiar with the apparatus was carried out using O-rings made of nitrile rubber. The compounding recipe for stocks based on Hycar 1001 is as follows:

Compound 1837-A
Cure: 90 minutes at 310 F.

Hycar 1001	100.00
ELC Magnesia	100.00
Zinc Oxide	5.00
Stearic Acid	1.50
Methyl Tuads	0.25
Sulfur	0.25

This formulation was a result of work carried out at Battelle Memorial Institute to develop materials resistant to hydraulic fluids at elevated temperatures.

Figure 5 presents a comparison of the original properties of this stock and properties determined by the use of the Type I Tester at 325°F. while the samples were immersed in various media. It can be seen that aging in nitrogen has the least deleterious effect upon the specimens and that the 70/30 isooctane-toluene mixture the more deleterious effect of the two fuels.

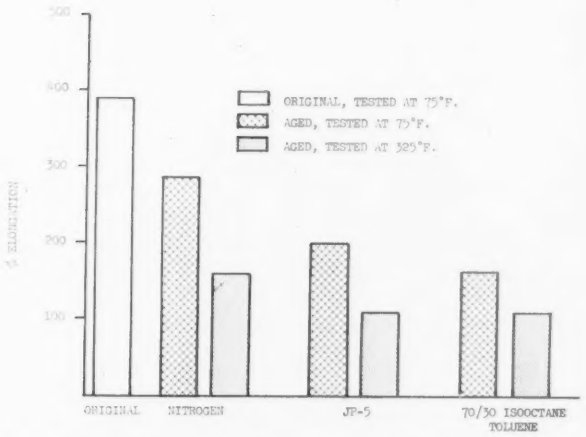


FIG. 7—Comparison of elongations of a nitrile rubber stock after aging for 72 hours at 325°F. while still in the aging media and at 75°F. after removal from the aging media.

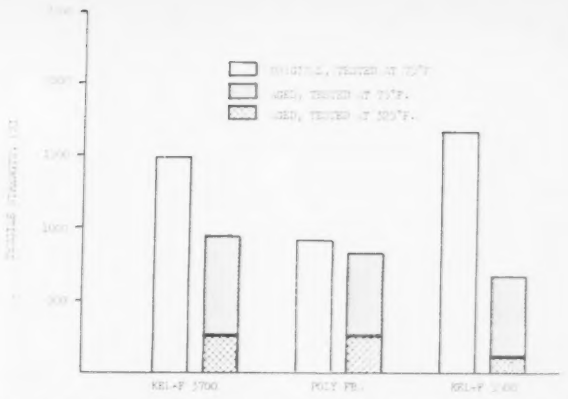


FIG. 8—Comparison of tensile strengths of Kel-F 3700, Poly FBA and Kel-F 5500 compounds after aging at 325°F. for 72 hours in JP-5 while still in the aging medium and at 75°F. after removal from the aging medium.

Air aging, which proved to be much more harmful than aging in nitrogen although the period of aging was only one-third as long, emphasizes the role of oxygen on high temperature aging.

The need for measurements which simulate use conditions of O-rings is amply illustrated by Figures 6 and 7. Figure 6 compares the tensile strengths of O-ring specimens measured at the termination of aging while specimens are at elevated temperatures and still in the aging media, and tensile strengths at room temperature after removal from the various media. The former measurements were made using the Type I Tester and the latter were made using conventional test equipment after the O-ring specimens had been aged in sealed glass tubes.

Examination of the data shows that aging in nitrogen exhibits the best agreement between hot and cold tensiles after aging, with a hot tensile of 46 percent that of the cold tensile. Aging in JP-5 exhibits the poorest agreement, with a hot tensile of 22 percent that of the cold tensile. Aging in 70/30 isooctane toluene is intermediate at 37 percent. The increase in cold tensile after aging in nitrogen and JP-5 is ascribed to post-curing.

Figure 7 illustrates similar data for elongation. While agreement between hot and cold elongations and between samples is better than was found for tensile measurements, it will be noted that major reductions in elongation are obtained with each aging media.

Essentially no volume change was obtained for samples aged in nitrogen, +10 percent was obtained in JP-5, and +21 percent was obtained in 70/30 isooctane-toluene. All samples passed a 180° bend test.

Figure 8 presents a comparison of tensile strengths of Kel-F 3700, Kel-F 5500, and Poly FBA compounds. Unfortunately, the O-rings were prepared elsewhere and knowledge other than as to base polymer is very general. However, the data at least gives an idea of the order of physical properties encountered at high temperatures in fuels.

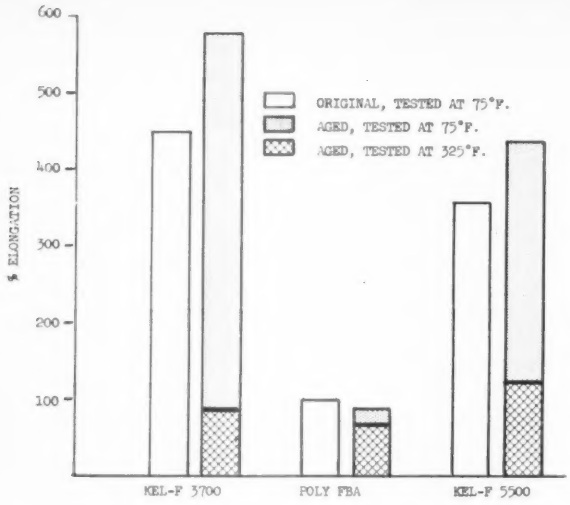


FIG. 9—Comparison of elongations of Kel-F 3700, Poly FBA and Kel-F 5500 compounds after aging at 325°F. for 72 hours in JP-5 while still in the aging medium and at 75°F. after removal from the aging medium.

In original tensile strength both the Kel-F elastomers exhibit a much higher tensile and elongation than Poly FBA. After aging for 72 hours at 325°F. in JP-5, however, Poly FBA is comparable to Kel-F 3700 at 75°F. and at 325°F., and is superior to Kel-F 5500 at both temperatures.

Figure 9 presents elongations for the same compounds. Poly FBA exhibits an original elongation of less than one-quarter that of either of the Kel-F stocks. After aging, both Kel-F's exhibit slightly higher elongations when tested at 75°F., while at 325°F., both elongations are considerably decreased. Poly FBA exhibits little change in elongation.

These data indicate, then, that these Kel-F 3700 and Poly FBA vulcanizates are comparable in heat-aged properties and superior to Kel-F 5500 vulcanizates. Work recently initiated in our laboratory, however, strongly indicates that Kel-F 3700 can be compounded to give aged properties considerably better than those of Poly FBA.

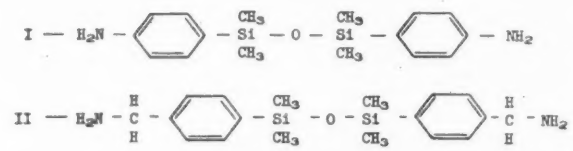
Although very few data were available at the time of writing, compounds based on Viton A appear very promising. Those which were available on the physical properties of Viton A vulcanizates follow:

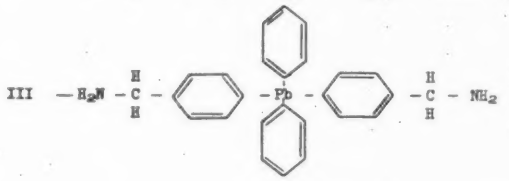
	Original	Heated to 400° in JP-5	Aged 72 Hours at 400°F. in JP-5
Tensile Strength, psi	1850	310	280
Per Cent Elongation	230	120	140
Test Temperature, °F.	75	400	400

As noted, the aging temperature was increased to 400°F. The original properties are entirely adequate, and on continued aging for 72 hours in JP-5 at 400°F., changes are minor. More work using Viton A compounds is now in progress.

Although considerable effort has been directed toward new base polymers of high thermal resistance, little effort has apparently been placed on the development of more temperature-resistant curing agents. This has led to the speculation that vulcanizate deterioration on high temperature aging may be, at least in part, due to deterioration of the cross-links rather than the base polymer—hence, more resistant cross-linking agents might result in lower vulcanizate deterioration.

A literature search revealed several diamines which should be more temperature resistant than a conventional diamine curing agent such as hexamethylene diamine. These formulas follow:





Basically, this idea boils down to replacing a major portion of the carbon chain nucleus of hexamethylene diamine with inorganic and organic ring substituents.

We now have evidence that compounds in which the amino group is attached directly to the benzene ring are not active enough to cause a cure, and hence have included an intermediate methylene group to increase the activity of the amine. This may weaken the thermal stability somewhat, but should still result in a compound more stable than the conventional carbon chain type. Data for these compounds will be available in the near future.

Summary

To summarize briefly, an apparatus has been described which permits the determination of physical properties of elastomeric materials at temperatures up to 400°F. while immersed in fuels.

Of the elastomers tested, Viton A appears to be of most interest in regard to fuel resistance at high temperatures.

Lastly, new partially inorganic curing agents are being prepared in an attempt to raise the thermal resistance of vulcanizate cross-links.

ACKNOWLEDGEMENT

This study was performed as part of a program sponsored by Wright Air Development Center [USAF Contract No. AF 33(616)-2779]. The authors are indebted to E. R. Bartholemew and R. E. Headrick for their advice and guidance throughout the program.

Determination of Tire Tread and Tread Rubber Profile

A report on an instrument which gives an instantaneous indication

By CHARLES B. ZIMMER

President, Industrial Gauges Corp., West Englewood, N. J.

THE problem was recently presented to Industrial Gauges Corp., West Englewood, N. J., of producing an instrument which would give an instantaneous profile indication of tire tread and tread rubber (camelback) as it leaves the extrusion press. This information would aid the operator in the initial set-up of the contour of the die, reducing the time needed for proper adjustment and, in addition, loss of scrap rubber during the operation.

The instrument needed for this requires a fairly rapid traverse so that the cross-section profile is not distorted by longitudinal variations. The XactRay Gauge produced by Industrial Gauges has an almost intantaneous response—a characteristic said to be found in no other radiation gauge—and so is ideally suited for this application. The standard gauge, with minor modifications depending on the specific application, provides the discrimination required at the traversing speeds at which the tread stock leaves the extruder.

On the production line, the XactRay Gauge can be mounted on a carriage which will transport it across the full width of the strip at a pace sufficiently rapid so that the cross-section thickness determination will have no error introduced by longitudinal variations of the extrusion. A traverse time of from 2 to 4 seconds is more than adequate. The measurement can be made at the

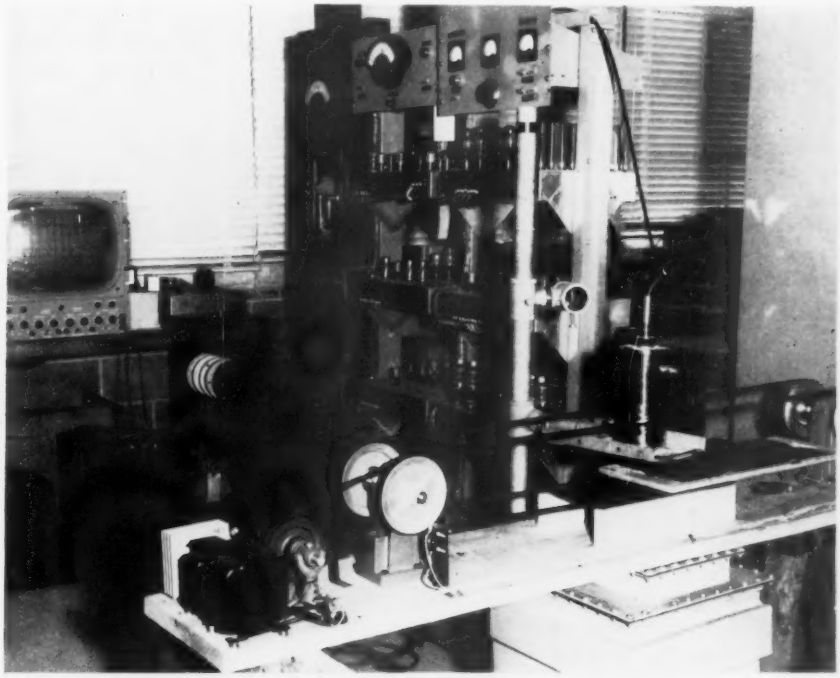


FIG. 1—Laboratory set-up of the XactRay Gauge and oscilloscope with persistent screen as used in giving a profile indication of tire tread and tread rubber as it leaves the extruding machine.

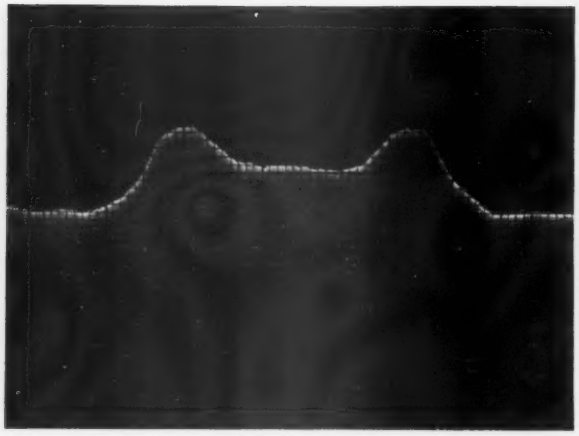


FIG. 2—A representation of the profile of a tire tread as recorded on the oscilloscope during a laboratory test of operating procedure.

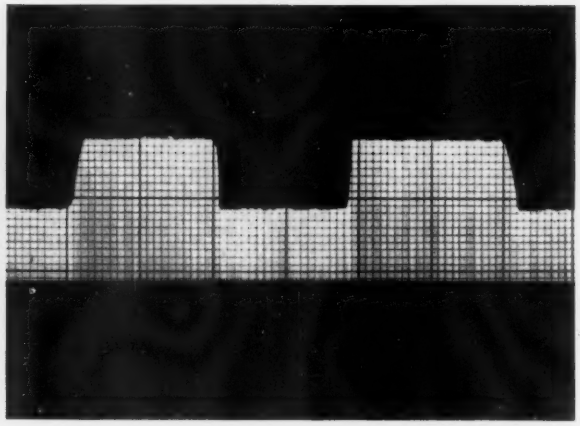


FIG. 3—A representation of the profile of a tread specially designed to test the capacity of the recording gauge beyond ordinary conditions.

first place on the extruded tread that the operator considers suitable.

The gauge naturally has to provide a picture of the profile if it is to be useful. Investigation of all the commercially available recorders showed that none had the speed of response required to produce the needed profile indication without serious distortion. However, an oscilloscope with persistent screen can be adjusted to provide the necessary speed of response, and can be equipped with a face sufficiently large to scale off thickness variations up to the limit of accuracy of the gauge itself. A set-up using these two instruments and simulating production line conditions was constructed in the Industrial Gauges laboratory for testing purposes, as shown in Figure 1.

Testing Procedure

Sections of tread rubber were mounted on the conveyor belt (Figure 1) and transported laterally through the beam of the gauge. This procedure was used in lieu of transporting the gauge across the tread. No attempt was made to transport the extrusion longitudinally because it had been determined that it was possible to make the transverse scan in this manner without considering longitudinal variations.

The belts were driven at a pace which caused the material to pass from edge to edge through the beam in from four to five seconds. With minor modification of the gauge, this transverse speed can be increased several times without loss of discrimination. The gauge used was a standard laboratory unit which happened to be in operation in the laboratory and was, in fact, not the most suitable model for this determination, as it had the power to measure up to one inch of steel or about one foot of rubber, rather than the finer discrimination more suited for tread rubber.

As stated, no commercial recorder was adequate for giving the profile indication. An oscilloscope with a 17-inch screen of long persistence (P-7) was therefore used. The longitudinal scale, which showed the width of the rubber, had to be somewhat reduced to get the entire width indication on the screen. The thickness scale, however, could be multiplied five times, and the thickness variation thus read with an accuracy equal to that of the gauge—up to one percent of thickness if that degree of accuracy were required. A 21-inch oscilloscope of the same general characteristics is also available, and can be furnished with a considerably more persistent screen (P-19).

Profiles of tire treads were run using a vertical scale which corresponded to the thicknesses of the rubber, although maximum vertical scales would ordinarily be used to get the maximum accuracy of reading. The increase in vertical scale simply involves increasing the vertical amplifier gain of the instrument. Reduced horizontal scales were used. The illuminated area seen in Figure 2 shows the indication of one of the tread profiles. It is such a picture which the extruder operator would see and use in setting up his machine for production.

For testing purposes the screen of the oscilloscope was hooded about 18 inches. This was for use in a room with lighting considerably brighter than that found in the average industrial plant.

Since the average tread because of its gradual change of shape is a relatively easy cross-section to record, a more difficult challenge of the capabilities of the gauge was made by testing a cross-section formed by laying onto a strip of neoprene two blocks of the same material cut with one side vertical and the other side with some slant. This simulated a cross-section much more difficult to trace than any the gauge would ever be called upon to describe in actual practice. The vertical rises with the sharp corners at the top necessitated an almost instantaneous response of the machine to give an accurate indication. Figure 3, a photograph of the oscilloscope screen, proves that the XactRay successfully met this challenge.

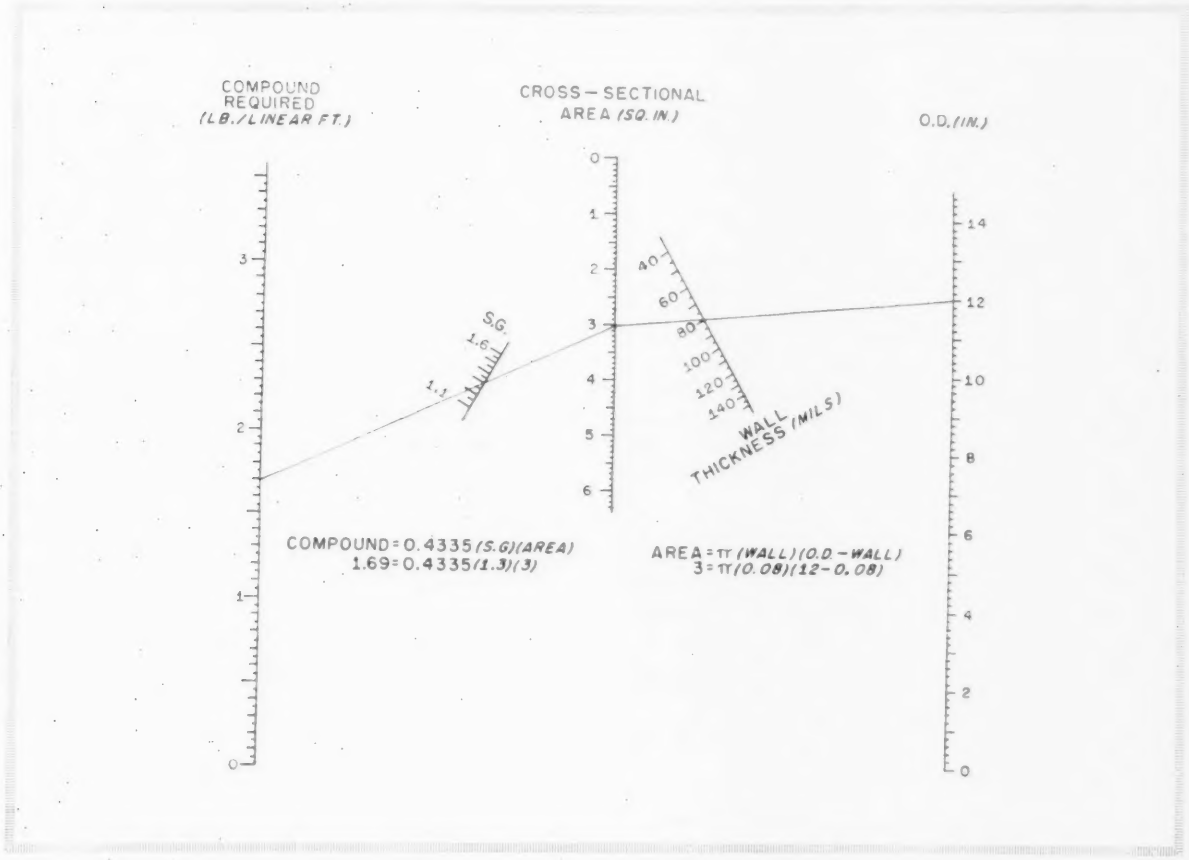
The tests described in this article demonstrate that an instantaneous and accurate cross-section profile of tire tread and tread rubber can be furnished to an extruder operator at the point of extrusion. This profile can amplify the thickness scale five times and thus provide the operator with an accurate tool in initial set-up, greatly reducing time and test material required for this operation.

How to Determine Stock Requirements for Tubing

Use of the nomograph in figuring pounds of stock per lineal foot of tubing

THE nomograph shown in the accompanying illustration was designed by the Silicones Division of Union Carbide Corp. for rapid calculation of the amount of Union Carbide silicone stock needed to make one lineal foot of either industrial or military hot air ducting. However, its use is applicable to any silicone tube extrusion up to 14 inches in diameter with a wall thickness from 40 to 150 mils, if the stock ranges in gravity from 1.1 to 1.6. It is suggested that, since it theoretically computes an exact pound requirement, allowance should be made for loss due to trim or scrap.

Determination of the amount of compound necessary for one lineal foot of tubing is made in the following manner. If the tubing has a 12-inch outside diameter with an 80 mil wall thickness, a line is drawn from the 12-inch point of the scale at the right, which represents outside diameter, through point 80 of the wall thickness scale. This line will cross the column in the center at 3, which indicates a 3-square inch cross sectional area for the tubing. If the specific gravity of the stock is 1.3, another line is drawn from 3 on the cross-sectional area scale through 1.3 of the specific gravity column. This line will cross the scale at the left at 1.6, which is the pounds of stock needed for each lineal foot of the tubing.



Thermal Diffusivity of Butyl Rubber and Its Compounds

Part II: Application of Diffusivity Coefficients

By Donald R. MacRae* and R. L. ZAPP
Enjay Laboratories, Linden, N. J.

The thermal diffusivity coefficients of a variety of butyl rubber compounds, determined as described in Part I [RUBBER AGE, Vol. 82, p. 831 (1958)], were applied to representative heating problems during vulcanization. The coefficients were utilized in the heating of large slabs wherein the length and width were considered to be much larger than the thickness dimension. Sample calculations illustrate how a series of tables and charts were designed so that final center temperatures could be estimated graphically.

These charts were presented in two forms. The first form gave curves of heating times as a function of pigment loading with slab thicknesses as parameters. Vulcanization conditions at 340°F. and 320°F. were assumed, and times required to heat the centers of slabs to 310°F. were plotted. By interpolation, the heating times for a wider variety of slab thicknesses could be estimated. Another set of charts presented the same heating time as a direct function of slab thickness with pigment loading as parameters. A more precise estimate of the effect of thickness can be obtained with these charts.

Finally, a constant curing time was considered, and variable center temperatures as a function of sample thickness were determined. Such a series of charts graphically showed that definite heating problems can arise when slabs of greater thickness than one-half inch are vulcanized.

IN Part I, the methods of determining thermal diffusivity coefficients were discussed. The methods were based upon the concept of Williamson and Adams [*Physical Review*, Vol. 14, p. 99 (1919)], which stated that the relationship between the surface temperature and the center temperature of a block of rubber during heating is related to a function of the constant, K, the time, t, and the thickness of the rubber article. The Williamson and Adams relationships are summarized in Figure 1, where heating curves for a sphere and for a large slab are plotted. The diffusivity coefficients were determined using spherical rubber specimens and these coefficients were applied to large slabs since such a shape is more representative of cured rubber articles. In Figure 1, the general equation is written along with explanations for the various symbols.

By way of review, the diffusivity coefficients for the butyl rubber compounds determined in Part I are presented in graphical form in Figure 2. It will be recalled that these coefficients were determined for an average temperature of 210°F. In Figure 2, these coefficients are plotted as a function of pigment loading. The pigments used were HAF carbon, MT carbon, SAF carbon, and a ground whiting. It can be seen from this figure that as pigment loading is increased, the thermal diffusivity constant is also increased.

It can also be observed that the effect of various types of carbon blacks is not the same. For example, HAF carbon with a higher structure index imparts greater conductivity to a butyl rubber mix than does the finer SAF carbon. A well-known carbon black manufacturer gives the structure index of HAF carbon as 100 and the SAF carbon as about 70. It can be allowed that the higher structure carbon presents more free carbon paths through which heat can be conducted.

The mineral filler, ground whiting, presents an entirely different case, and its lower over-all contribution to conductivity can probably be explained by poor wetting between such a hydrophilic pigment and butyl rubber. A point at 0 parts of pigment represents the experi-

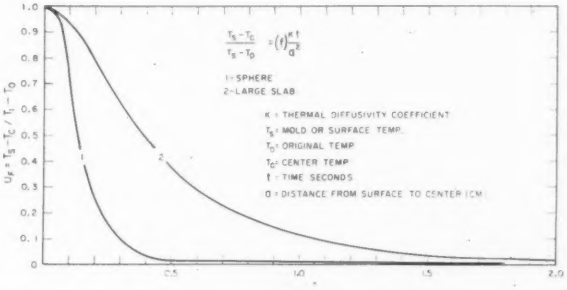


FIG. 1—Temperature change of a rubber body when subject to heating according to Williamson and Adams.

* Present address: Tekn. Org. Kemi (KTH), Stockholm 70, Sweden.

Note: This paper was presented before the Division of Rubber Chemistry, American Chemical Society, at Montreal, Quebec, Canada, May 16, 1957.

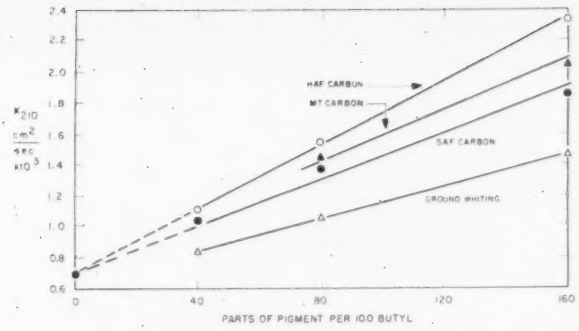


FIG. 2—Diffusivity coefficients of butyl rubber at 210°F. as a function of pigment loading.

mentally determined diffusivity coefficient for a non-pigmented butyl vulcanizate. It appears that the lines for carbon black, if projected to 0 loadings, proceed through this experimentally determined point.

As indicated in Part I, the diffusivity coefficients vary with average temperature, so that each coefficient should be accompanied by a temperature dependence value. The temperature dependence of the coefficient for pigmented and non-pigmented butyl rubber compounds is shown in Figure 3. Here all the carbon black types appear to fall in the given line, and as carbon black loading is increased, the temperature dependence of thermal diffusivity is decreased. In other words, the thermal diffusivity coefficients have a negative temperature dependence. The values for the ground whiting temperature dependence appear well below the carbon black compounds as shown.

Sample Calculations

There are five variables in the Williamson and Adams relations: (1) Temperature of the surface or mold, (2) Original temperature of the rubber compound, (3) Temperature at the center of the rubber, (4) Time of vulcanization, and (5) Thickness of the article. If any four

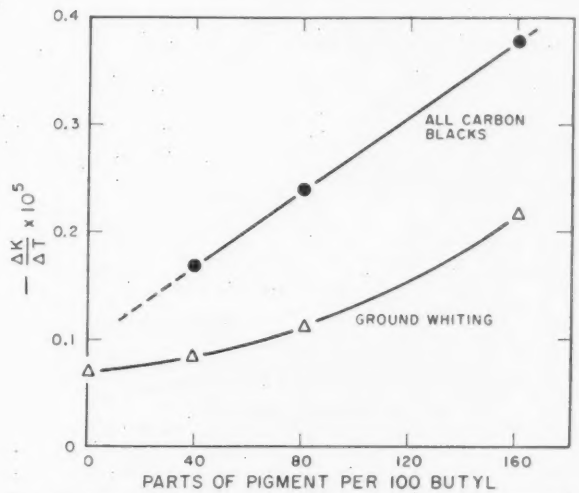


FIG. 3—Thermal diffusivity temperature dependence of pigmented and non-pigmented butyl rubber compounds.

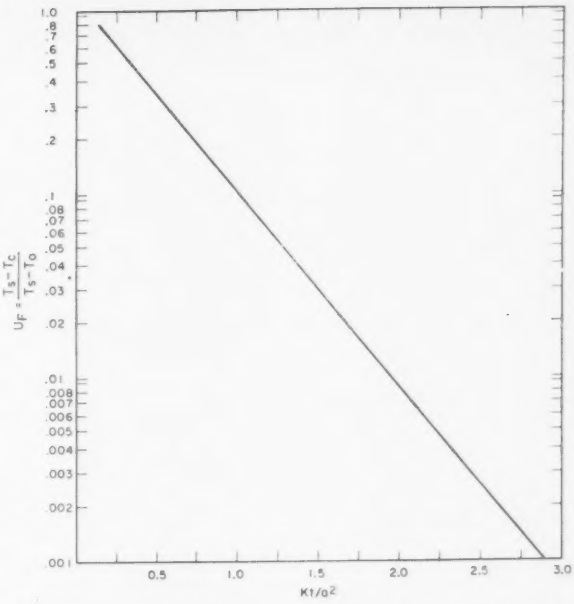


FIG. 4—U_F versus Kt/a^2 for a slab of butyl rubber. (Data from Williamson and Adams).

of these variables are known, the other can be determined.

Required Time of Heating. First let us consider the time required to heat the center of a slab of given thickness to within 10°F. of the surface or mold temperature. Suppose the slab were one-half inch thick, it contained 40 parts of an SAF carbon, and the mold temperature was 320°F. The problem is to find the time required to heat the center of the slab to 310°F. when the original stock temperature is 80°F.

$$\frac{Ts - Tc}{Ts - To} = \frac{320 - 310}{320 - 80} = \frac{10}{240} = 0.041$$

From Figure 4, which is a semilogarithmic plot of curve 1 in Figure 1, $Kt/a^2 = 1.38$ when $Ts - Tc/Ts - To = 0.041$.

The average temperature of the rubber compound during the curing process is assumed to be the average of the original temperature, 80°F., and the mold temperature, 320°F. The average is thus 200°F. From Figure 2, the thermal diffusivity coefficient at 210°F. for 40 parts of SAF carbon in butyl rubber is 1.06×10^{-3} cm.²/sec. At 200°F. this is increased by $10 \times 0.17 \times 10^{-5}$ cm.²/sec./°F. as indicated from the temperature dependency curves of Figure 3. K, the thermal diffusivity coefficient for the compound in question, is thus $1.06 \times 10^{-3} + 0.17 \times 10^{-4}$ in 1.08×10^{-3} cm.²/sec.

The thickness of the slab is ½-inch and thus the distance from center to surface is ¼ inch or 0.635 cm. Then,

$$\frac{Kt}{a^2} = 1.38 = \frac{1.08 \times 10^{-3} \times t}{(.635)^2}, \text{ and}$$

$t = 516$ seconds or 8.6 minutes.

Center Temperature for a Given Curing Time. Another problem frequently encountered in vulcanization is

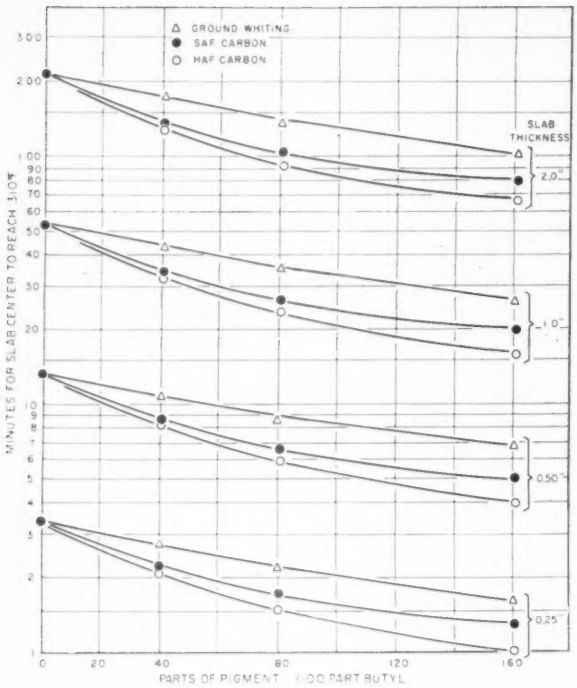


FIG. 5—Heating of butyl rubber as a function of filler loading with vulcanization at 320°F.

the determination of the center temperature for a given curing time. For simplicity let us select the same mold temperature of 320°F. and cure for 20 minutes. The original stock temperature is again 80°F. This will give an average stock temperature of 200°F. Let us use the same 40 part SAF carbon-butyl compound whose thermal diffusivity coefficient was given as 1.08×10^{-3} cm.²/sec. at 200°F. average temperature. To exaggerate the effect of slab thickness, let us try to heat a slab ¾ of an inch thick. Thus

$$a^2 = \left(\frac{0.75 \times 2.54}{2} \right)^2 = 0.9, \text{ and}$$

$$Kt/a^2 = \frac{1.08 \times 10^{-3} \times 20' \times 60}{0.9} = 1.44.$$

From Figure 2

$$\frac{Ts - Tc}{Ts - To} = 0.036, \text{ when}$$

$$Kt/a^2 = 1.44.$$

Thus,

$$\frac{320 - Tc}{320 - 80} = 0.036 \text{ or } Tc = 311°F.$$

Heating Time and Filler Loading

The sample calculations discussed in the previous section illustrate how a table of values can be constructed for a variety of conditions. Calculations were made for two vulcanizate conditions. First, we determined the heating times required for the center of a large slab to reach 310°F. when the press temperature is 320°F. Such a table of values is shown in Table I for the three types of pigment loadings. The first series of values in Table I show the required heating times for various loadings of SAF carbon black. These required heating times are calculated for slabs of every increasing thickness.

From the values of Table I it can be seen that slab thicknesses of over ½-inch will present heating problems during vulcanization, and as shown under the column for the one inch thick slab, heating times required to get the center of the rubber to 310°F. become larger than many conventional curing cycles. The values under the two inch thick slab show almost "astronomical" increases in heating times, so that it would be rather impractical to vulcanize such a thick specimen.

The same series of calculations are made for HAF carbon-butyl rubber compounds. In general, the heating times required are somewhat shorter than with the SAF black, reflecting the greater thermal diffusivity coefficient of this type of carbon. The third series of values in Table I are for mixtures of butyl rubber and ground whiting. Here the lower conductivity of such mixtures requires much longer heating times, especially for slab thicknesses of one inch or larger.

The data of Table I are plotted on a semilogarithmic scale in Figure 5. An over-all picture of the effect of pigment type loading and slab thicknesses can be immediately obtained. The time scale is plotted as a logarithmic ordinate. From a figure such as this, heating times for these vulcanization conditions can be estimated for a wide variety of compounds and slabs, for one can interpolate for thicknesses that might differ from the exact ones plotted here.

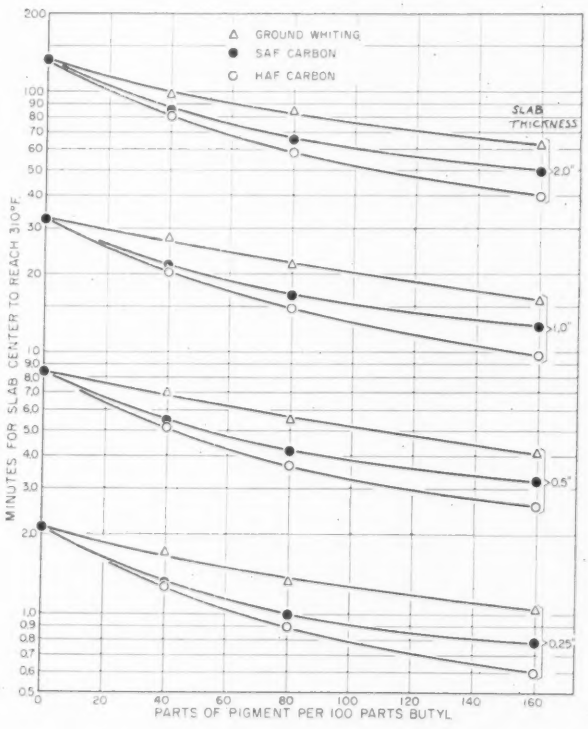


FIG. 6—Heating of butyl rubber as a function of filler loading with vulcanization at 340°F.

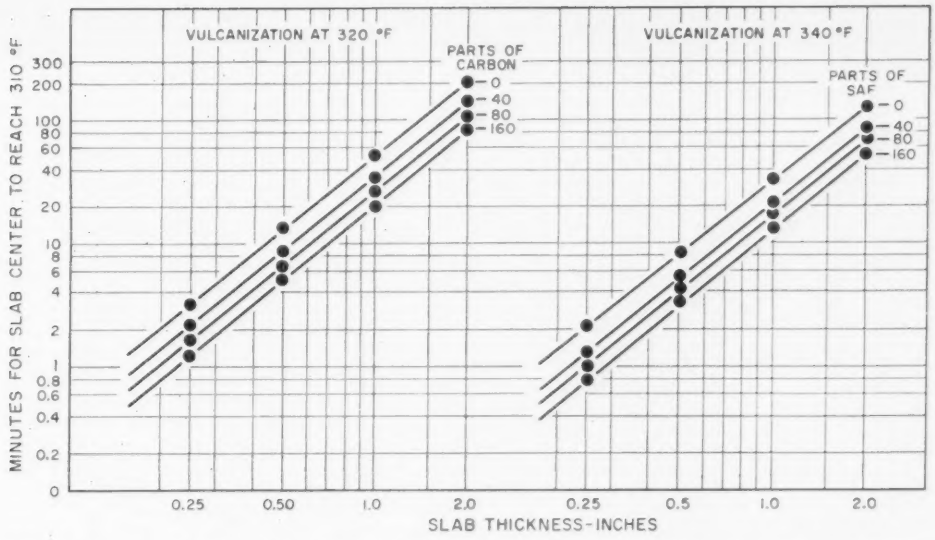


FIG. 7—Heating of butyl rubber-SAF carbon black compounds with vulcanization at 320°F. and 340°F.

Effect of Press Temperature on Heating Time

One way to decrease the required time for the center of a slab to reach 310°F. would be to increase the surface or mold temperature. Such a series of calculations has been made for a vulcanization process that is carried out at 340°F., as shown in Table II. Here we want to achieve the same center temperature of the rubber slab, and the calculations show that the increased surface temperature markedly reduces the heating times, as would be expected.

The values of Table II are calculated for the same butyl rubber compounds containing various SAF, HAF carbon and ground whiting. The values displayed in Table II are plotted in Figure 6 so that heating times can be graphically obtained for a wide variety of pigment loadings and slab thicknesses. As before, interpolation between the various curves can give estimations of required heating times for slab thicknesses differing from the exact ones plotted here.

From the position of the curves in Figures 5 and 6, it is readily seen that the effect of slab thickness on re-

TABLE I—EFFECT OF PIGMENT LOADING ON TIME NEEDED TO HEAT THE CENTER OF A SLAB TO 310°F.

PRESS TEMPERATURE OF 320°F.; Stock temperature of 80°F.

Parts Loading Per 100 Parts Butyl Rubber	Thermal Diffusivity K at Avg. Temp. 200°F.	Minutes Required to Heat Center of Slab to 310°F. as a Function of Thickness 0.25 in.	0.5 in.	1.0 in.	2.0 in.
	SAF CARBON BLACK				
0	0.69 x 10^{-3}	3.3	13.6	53.4	215
40	1.08 x 10^{-3}	2.2	8.6	34.1	136
80	1.39 x 10^{-3}	1.7	6.7	26.5	106
160	1.85 x 10^{-3}	1.3	5.0	20.0	80
	HAF CARBON BLACK				
0	0.69 x 10^{-3}	3.3	13.6	53.4	215
40	1.14 x 10^{-3}	2.1	8.2	32.5	130
80	1.58 x 10^{-3}	1.5	5.9	23.4	94
160	2.35 x 10^{-3}	1.0	3.9	15.8	68
	GROUND WHITING				
0	0.69 x 10^{-3}	3.3	13.6	53.4	215
40	0.84 x 10^{-3}	2.8	11.0	44.1	177
80	1.07 x 10^{-3}	2.2	8.6	35.4	139
160	1.47 x 10^{-3}	1.6	6.7	25.2	101

TABLE II—EFFECT OF PIGMENT LOADING ON TIME REQUIRED TO HEAT THE CENTER OF A SLAB TO 310°F.

PRESS TEMPERATURE OF 340°F.; Stock temperature of 80°F.

Parts Loading Per 100 Parts Butyl Rubber	Thermal Diffusivity K at Avg. Temp. 200°F.	Minutes Required to Heat Center of Slab to 310°F. as a Function of Thickness 0.25 in.	0.5 in.	1.0 in.	2.0 in.
	SAF CARBON BLACK				
0	0.69 x 10^{-3}	2.1	8.5	32.8	132.0
40	1.06 x 10^{-3}	1.3	5.5	21.3	85.0
80	1.37 x 10^{-3}	1.0	4.2	16.4	66.0
160	1.81 x 10^{-3}	0.8	3.2	12.5	50.0
	HAF CARBON BLACK				
0	0.69 x 10^{-3}	2.1	8.5	32.8	132.0
40	1.12 x 10^{-3}	1.3	5.2	20.0	80.0
80	1.55 x 10^{-3}	0.9	3.7	14.6	58.0
160	2.31 x 10^{-3}	0.6	2.5	9.7	39.5
	GROUND WHITING				
0	0.69 x 10^{-3}	2.1	8.5	32.8	132.0
40	0.83 x 10^{-3}	1.7	7.0	27.2	98.0
80	1.06 x 10^{-3}	1.3	5.5	21.3	85.0
160	1.45 x 10^{-3}	1.0	4.0	15.6	62.0

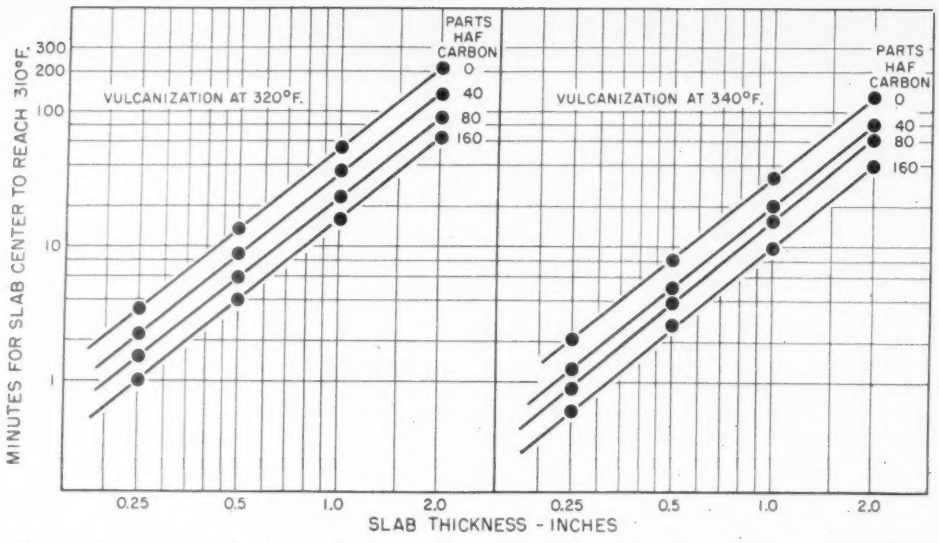


FIG. 8—Heating of butyl rubber-HAF carbon black compounds with vulcanization at 320°F. and 340°F.

quired heating times is logarithmic. Another series of curves is plotted in Figures 7 and 8 in an attempt to simplify possible graphical estimations of required heating times for carbon black compounds.

In Figure 7, for example, the two vulcanization conditions of 320°F. and 340°F. are presented in a separate series of lines for compounds of one type of carbon. The required heating times are plotted as a function of slab thickness on full logarithmic coordinates. The result is a series of parallel straight lines with carbon black loading as the parameters.

A similar series of lines on the right hand side of Figure 7 are positioned at a lower level showing how the increased surface temperature reduces required heating times to reach 310°F. for any given butyl rubber compound. These curves allow one to estimate heating times for a variety of slab thicknesses more accurately than could be done in Figures 5 and 6. Figure 7 gives lines for a SAF carbon black-butyl rubber series, and Figure 8 is for a HAF carbon black series.

A comparison of the various lines, then, show that the HAF carbon produces a more conductive mixture for a given loading. This is especially true at higher loadings of carbon black. Again on the right hand side of Figure 8, vulcanization at 340°F. reduces markedly the time required for the center of a given slab thickness to reach 310°F.

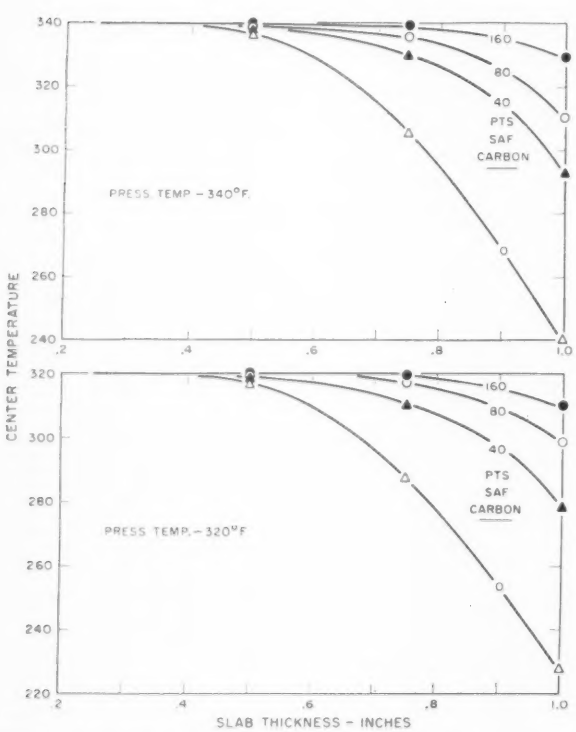


FIG. 9—Temperature at center of slabs of butyl rubber at end of 20 minute curing cycles at 320°F. and 340°F.

Center Temperature and Constant Heating Time

With many temperature conducting problems, the heating time is dictated by a given curing cycle. Calculations were made with this point in view in order to determine a practical limiting thickness when a constant heating time is considered. The calculations differ from those in the earlier part of the report in that Tc, the temperature at the center of the slab, is the unknown variable; however, the method is quite similar as discussed when describing sample calculations.

The results of a series of calculations to determine center temperatures for a given curing time are presented in Tables III and IV for butyl rubber-SAF carbon black mixtures. The conditions were first given as a 20 minute curing cycle with a 340°F. mold or surface temperature. Calculations were made for the same series of carbon black loadings. Center temperatures are placed in columns under each slab thickness. It is readily seen that thin slabs, such as ¼ inch, readily reach the surface temperature of 340°F. within the 20 minute curing cycle. This is also practically true for the ½ inch thick

TABLE III—TEMPERATURE OF CENTER OF SLABS AT END OF 20 MINUTE CURING CYCLE

Press temperature of 340°F.; Stock temperature of 80°F.; Average temperature of 210°F.

Parts of SAF Carbon/100 Butyl Rubber	K at Avg. Temp. 210°F.	Temperature in °F. as Related to Slab Thickness 0.25 in.	0.50 in.	0.75 in.	1.0 in.
0	0.69 x 10	340	337.4	306	241
40	1.06 x 10	340	339.7	330	293
80	1.37 x 10	340	339.8	336	310
160	1.81 x 10	340	339.9	339	329

TABLE IV—TEMPERATURE OF CENTER OF SLABS AT END OF 20 MINUTE CURING CYCLE AT A PRESS TEMPERATURE OF 320°F.

Parts of SAF Carbon/100 Butyl Rubber	K at Avg. Temp. 210°F.	Temperature in °F. as Related to Slab Thickness 0.25 in.	0.50 in.	0.75 in.	1.0 in.
0	0.69 x 10	320	317.9	287	228
40	1.08 x 10	320	319.8	311	278
80	1.39 x 10	320	319.9	317	298
160	1.85 x 10	320	320.0	319	310

slab. However, when thicknesses are increased from this point, the center temperatures begin to diverge markedly from the surface temperature. By referring to the 40 part SAF black carbon, one can see that the center temperature reaches only 293°F. when the slab is one inch thick. Therefore, the center of such a thick specimen would be at a drastic state of undercure if vulcanization ingredients were added to obtain optimum states of cure at 340°F.

This effect is further emphasized when the press temperature is reduced to 320°F., as shown in Table IV. Here the 40 part SAF carbon black compound reaches only 278°F. in the 20 minute curing cycle. Our background in butyl rubber indicates that temperatures as low as this would result in only marginal curing. The data of Tables III and IV are plotted in Figure 9.

The top portion of Figure 9 presents the center temperature when the press temperature is at 340°F. These curves, plotted on rectangular coordinates, show the rapid drop-off of center temperatures when slab thicknesses increase above ¾ of an inch. This is most obvious at normal or low loadings of carbon black. The bottom section of Figure 9 gives a similar series of curves when the temperature is at 320°F. and shows emphatically the curing problems that arise when attempts are made to vulcanize thick articles.

Coming Next Month...

Effects of TDI (Toluene Diisocyanate) Isomer Ratio in Polyurethane Foams—By G. T. Gmitter and E. E. Gruber, General Tire & Rubber Co., Akron, Ohio.

Discussion of a formulation factor in making urethane foams which has not been fully exploited, with information on blends which offer a higher degree of optimum properties, both physical and processing.

Low Cost Compounding with Oil-Extended Rubber—By Z. J. Dorko and H. A. Pfisterer, Polymer Corporation, Ltd., Sarnia, Ontario, Canada.

A detailed compounding study of two Polysar elastomers with recipes for stocks to meet specific applications.

An Evaluation of Mercaptan Type Chemical Peptizers—By M. B. Neuworth, Pitt-Consol Chemical Co., Newark, N. J.

Performances of two mercaptan rubber peptizers (thiocresols and thioxlenols) based on a new raw material source are compared with those of two commercial mercaptan peptizers.

Properties and Uses of Fusible Silicone Rubber Compounds—By F. Fekete and J. H. Lorenz, Union Carbide Corp., Tonawanda, N. Y.

Analysis of a new family of silicone rubber compounds which are fusible, with an insulating and a conductive member presented in detail. (Note: This article was originally scheduled for March.)

Abstracts of Papers to be Presented at the Spring Meeting of the Division of Rubber Chemistry, A.C.S.

Complete abstracts of all the papers to be presented at the meeting in Cincinnati, Ohio on May 14-16.

Editorials..

How Not to Sell a Tire

► Fellow we know happened to be in a rather populated area the other day—right near a major tire plant. As he tells the story, he decided to buy a set of tires at a local dealer. So he pulled his 1955 Cadillac into the dealer's service area and asked the man for the tires he needed. The model car which our friend was driving used the same size tire as the big Buick and several models in the Chrysler line. But the dealer didn't carry that size. Our friend had to take his business elsewhere. Moral of story: Can it be that too many dealers in too many lines are letting their inventories fall too low? Are these low inventories contributing to the slackened sales pace?

Conversation Piece

► It is always profitable to pay attention to some of the "old hands" in this business of ours. Their views often help us in clarifying the issues. H. E. Humphreys, Jr., chairman of the board of the U.S. Rubber Co., had some interesting things to say about the economy and the rubber industry before the recent decennial meeting of the Washington Rubber Group—things that bear repeating. The job of getting America out of its current recession lies primarily in the hands of business, said the U.S. Rubber executive, and "too much government tinkering" might well make it worse than it is. We must not wait for the government to help us out, he declared. "I feel that businessmen run too much to Washington as it is."

Mr. Humphreys went on to say that except in time of grave national emergency, government's business role is to set up and enforce whatever rules are necessary to strengthen competition. If the government will stick to this job, business can do more to keep the nation strong, he said. The main theme of Mr. Humphreys' talk was a plea that industry take stock of the ways it aids and can aid the nation's military and civilian strength in the present period of national emergency.

Each industry in America, Mr. Humphreys pointed out, should take stock of the ways it aids the nation's strength, then see what more it can do to add to that strength. He noted that there are six principal ways in which we can, and to a large extent already do, contribute to the nation's strength both on the defense front and on the civilian front:

(1) By maintaining an adequate and protected raw material supply.

(2) By responding to the forces of all-out competition.

(3) By maintaining a skilled work force in factory and laboratory.

(4) By maintaining financial strength.

(5) By continuing to expand research.

(6) By providing new and better products.

The rubber industry, he said, produces more than just rubber and rubber products. It is in plastics, chemicals, synthetic fibers, electronics, ordnance, propulsion and atomic energy. Such diversification puts the industry squarely in the foreground to be called upon by the government to help guard the nation's strength—both defense and civilian—today and in the future.

The rubber industry, however, has not done its best job in providing an adequate return on invested capital and the primary reason is that wage costs in the industry have increased 60 per cent in the past ten years while output rose only 24 per cent. "I strongly urge managements of all rubber companies to give the public the facts behind our profit squeeze," he declared.

He called the war-born synthetic rubber plants one of the industry's greatest assets for national strength, pointing out that in the three years since they were sold to private industry, production capacity has been expanded by 50 per cent and the quality of the product is without question. He commended the stockpile advisory committee of the Office of Defense Mobilization for recommending a three-year stockpile base for natural rubber. "Certainly it is more realistic than the five-year supply we have been maintaining," he stated. "And if an even smaller stockpile was considered enough by our military people, I'd certainly be in favor of it."

He cautioned, however, that a sudden dumping of stockpile rubber onto the market would cause an immediate break in rubber prices and would not be fair to either taxpayers or rubber producers. An orderly program, he said, should be developed to release rubber from the stockpile when demand is in excess of supply.

As for natural rubber itself, Mr. Humphreys stated that its long-term future depends upon a policy of producing a lot of rubber at a low price. Rubber can be raised under good conditions at prices as low as 9 or 10 cents a pound, he declared, but there are trade factors which work to keep prices higher. "If lower and more stable prices for natural rubber are delayed too long, the rubber producing countries will find that they have been holding an umbrella over the development of a synthetic which can replace it entirely," Mr. Humphreys observed.

It will be seen that Mr. Humphreys covered a good many points in his address—many of them highly controversial. It is not the purpose of this editorial to outline specific areas of agreement or disagreement. What should be said, however, is that here is a man who has given much time and thought to the problems of his industry and his country. His analysis is reasoned and articulate. It would be well for all of us to pay similar attention to the problems of the day for it is only in this way—through an interplay of ideas and opinions—that free man in a free society can best function. We hope that Mr. Humphreys' comments stimulate discussion and we intend to take part in this discussion in future issues.

Special Industry Report

Equivalent Cures in Specimens of Various Shapes

Some time ago a special Task Group of Sub-Committee X on Physical Testing of Rubber Products of Committee D-11 of the American Society for Testing Materials was appointed to study the problem of equivalent cures in rubber specimens of various shapes and thicknesses. The Task Group consisted of A. E. Juve (Goodrich Research) as chairman with F. S. Conant (Firestone) and J. F. Svetlik (Phillips Chemical). The results of a special investigation on this problem were reported before the Sub-Committee at the meeting held in St. Louis, Mo. on February 11, 1958. Because of its importance to the rubber manufacturing industry we are reproducing it in full herewith.—Editor.

THIS Task Group was assigned the job of studying the problem of equivalent cures in specimens of various shapes and thicknesses at the Spring meeting of Sub-Committee X in February, 1957. The assignment was not clearcut and it was soon apparent from the discussion that there were two separate and distinct phases involved:

(1) How does one adjust the curing times for various shapes and thicknesses to accomplish the same state of cure as in a standard tensile sheet at some specified time and temperature?

(2) How does either the manufacturer or the consumer determine that he has equivalent states of cure when he has a standard tensile sheet cured at a specified time and temperature and a product of different size and shape but cured at a different time and temperature?

A solution to the first phase of the problem requires a knowledge of the thermal properties of the stock in question, the dimensions of the part to be considered, and the temperature dependence of vulcanization. The latter information is also useful when it is required to transpose cures from one temperature to another.

The problem is confined to determining the added time required to adjust the cure for thicknesses greater than that of a standard tensile sheet. For articles of lesser thickness, no adjustment is required.

A nomograph is shown in Figure 1 which permits the calculation of the lag time or incubation time for articles of varying shapes and of varying compositions. The most favorable shape for low lag time is a sphere, while the most unfavorable shape is a thick flat slab of relatively large width and length. The second factor is the minimum dimension. In the case of the sphere this is the diameter, and for a large flat slab it is the thickness. For a block 1 x 2 x 3 inches it would be the 1-inch dimension.

The thermal diffusivity is important since this controls the rate of conductance of temperature through the object. The large effect of this factor can be seen at a glance.

It will be seen that the incubation time as scaled from this nomograph is assumed to be independent of the temperature. This is not strictly the case, since if the cure were to be conducted at room temperature there would be no incubation time. As the impressed temperature increases, the incubation time increases. The nomograph can be assumed to be accurate at 280° F., with approximately a 5% error for temperatures 60° F. higher or lower than 280° F.

Once the incubation time is determined, it is simply added to the cure time of the tensile sheet provided the latter is greater than the former. However, if the incubation time is longer than the tensile sheet cure, a correction, which is obtained from the curve in Figure 2, needs to be applied. The ratio of the tensile sheet cure, Te, to the incubation time, m, is first calculated. Then from the curve the factor t/m is scaled. This latter factor multiplied by the incubation time gives the cure time.

Thus, if the cure time for a tensile sheet

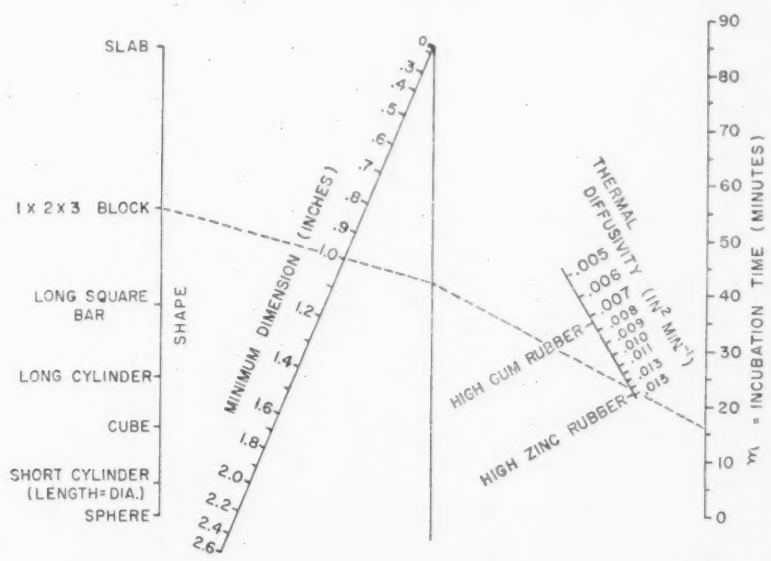


FIG. 1—Nomograph for calculating incubation time for articles of varying shapes and compositions.

The size, shape and compound of an article to be cured determine the incubation time. This time, denoted by m, may be obtained from the nomograph. Intermediate shapes may be interpolated on the scale on the left. The dotted line, for example, shows that a 1 x 2 x 3 inch block of tread stock will have an incubation period of 16 minutes.

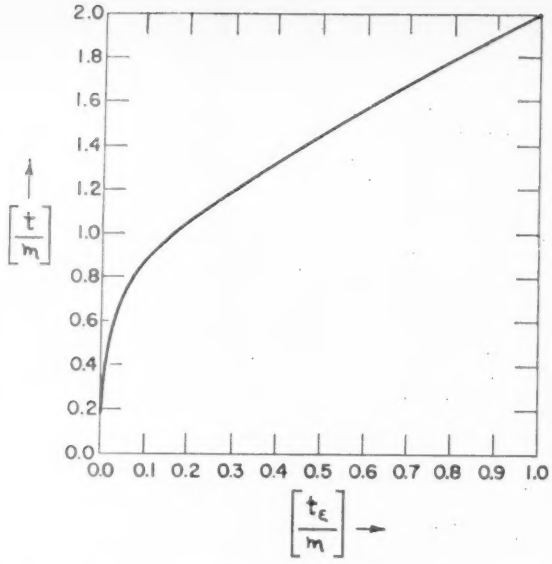


FIG. 2—Curve for determining incubation time if the incubation time is longer than the tensile sheet cure.

is 12 minutes and the incubation time is 120 minutes, the ratio of

$$\frac{te}{m} = 0.10.$$

From the curve, t/m is 0.87 whence $t = 120 \times 0.87 = 104$ minutes.

The construction of both the nomograph and the curve in Figure 2 involves calculations of the curing effect obtained during the heating-up period at temperatures lower than the impressed temperatures. To do this requires an assumption as to the temperature dependence of the cure rate. For this calculation it was assumed that the cure rate is doubled for an 18° F. increase in temperature. There are differences of opinion as to the value of this factor and claims that different curing systems and different polymers respond somewhat differently. However, a careful look at published data suggests that most of the work was not too carefully done and some results are based on sulfur combinations which are not applicable. The value used is an average figure which we believe to be fairly accurate. Actually a large error in this factor makes only a minor difference in the calculations so this is a relatively unimportant point.

Since frequently the establishment of a cure for a product involves not only an estimate of the incubation time but also a transposition from one curing temperature to another, it should be possible to transpose easily from one temperature to another. In this case the temperature coefficient is more important. Most technical men have one or several charts which have been published or prepared in their own company. These are based on various values for the temperature coefficient and most are subject to some question for the reasons given above.

The assumption that a factor such as 2/10° C. will apply over the entire temperature scale is subject to an appreciable error for temperatures which are different by a considerable amount. The rate of cure should depend on the absolute temperature and its logarithm should be inversely proportional to the reciprocal of the absolute temperature. The error is due to the fact that the differences between the reciprocals of curing temperatures which are 10° C. apart are different at the low end of the range, e.g., 110° C. to 120° C., from those at the high end of the range, e.g., 160° C. to 170° C.

The nomograph shown in Figure 3 was constructed on the basis of a reciprocal temperature scale on the right. The latter was constructed on the basis that in the 280 F. range the rate of cure is doubled for an 18° F. increase in temperature.

One additional point should be mentioned. If it is desired to transpose the cure of an article from one temperature to another and the cure time includes an incubation time, the latter should first be subtracted from the cure time before the temperature transposition is made.

The mistake which would result can be illustrated as follows:

Suppose a product is being cured 60 minutes at 280° F. and the sheet cure is 40 minutes at 280° and incubation time is 20 minutes. If it is desired to cure this product at 300° F., and the 60 minutes at 280° cure is transposed by Figure 3 to 300° F., we have 28 minutes at 300° F.

However, if the incubation time of 20 minutes is first subtracted and the transposition made, we find that 40 minutes at 280° F. is equal to 18 minutes at 300° F., and to this is added the 20 minute incubation time, giving a new cure of 38 minutes at 300° F.

The reason for this procedure is the point made earlier that the incubation time is essentially independent of the impressed temperature.

In the operation of this procedure there are usually two estimates involved which can be in error. In estimating the shape factor the product being considered is usually not a simple geometric shape and judgment or a guess is involved as to what point to select on the left hand scale of Figure 1. The second estimate involves the thermal diffusivity of the stock in question, which is not usually known with any certainty. Several values are indicated on the scale as a guide. Also in the accompanying table are listed some published data on certain rubbers and compositions.

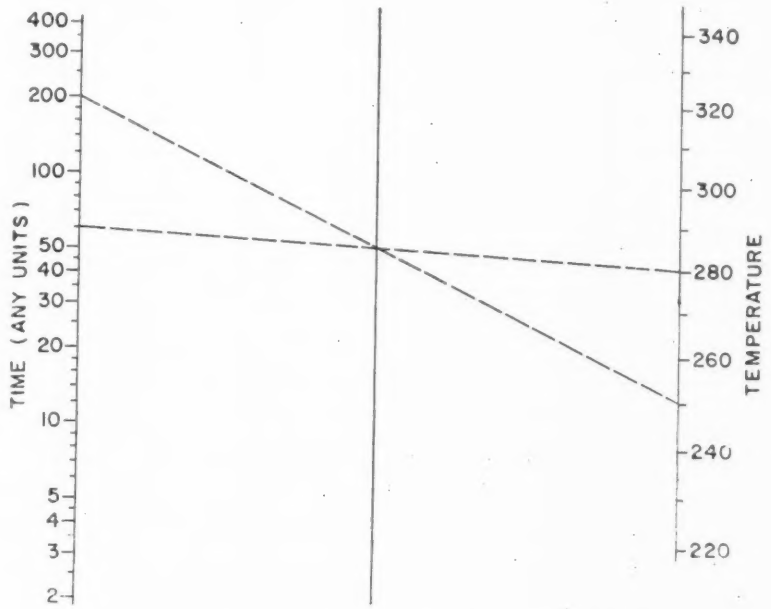


FIG. 3—Nomograph for transposing cures from one temperature to another.

In practice the usual procedure involves a calculation of the incubation time based on the best estimates of the shape factor and the thermal diffusivity. A trial cure is then run and based on tests or observations, an adjustment may or may not be required.

As an illustration of a means by which the lag time or incubation time may be determined as a check against the nomograph of Figure 1, the Task Group prepared slabs ½ inch thick and 1 inch thick at a series of cure times for several of the compositions given in Method D-15, and ran swelling tests on specimens cut from tensile sheets cured 40 minutes as well as specimens cut from each of the cures for the thicker slabs. A vertical slice approximately 0.075 inch thick was cut near the middle of each slab and from these slices specimens were prepared for immersion tests. Thus, each specimen included the more highly cured top and bottom surfaces as well as the less highly cured center section.

Swelling tests were run in three laboratories. The results obtained were somewhat erratic, particularly with the natural rubber stocks. This was investigated further and found to be due to reversion of these stocks with continued cure which gave U-shaped curves of swell versus time of cure, which do not lend themselves well to this technique.

One set of results which came out reasonably well is illustrated in Figure 4. This was the SBR tread-type stock and the data plotted are the averages of the results from the three participating laboratories.

The lag time is scaled off and shown on the curve along with the lag times calculated from Figure 1 using 0.014 as the thermal diffusivity. The agreement is reasonably good.

For the second phase of the assignment a procedure is required by means of which the state of cure in a product can be compared with the state of cure in a tensile sheet given the "best" or most desirable cure.

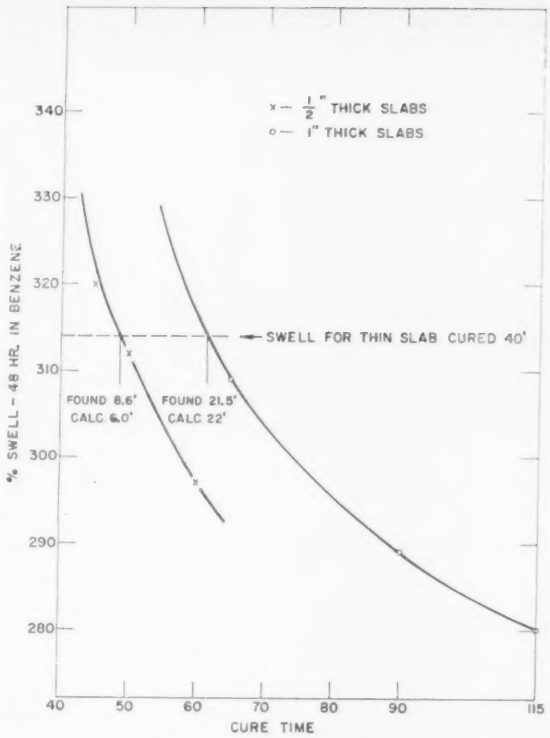


FIG. 4—Comparison of actual incubation time with calculated incubation time of a tread type stock.

This requires the selection of a property which is sensitive to state of cure. Further, the property should be capable of being accurately measured on specimens of shapes and dimensions different than that of a tensile sheet. Some properties which might be considered are the following:

(1) Free sulfur. This determination is applicable only to those materials which are vulcanized with elemental sulfur. It is a good method, when applicable, and does not depend on the geometry of the specimens.

(2) Solvent swelling. This is a very sensitive test for state of cure. It is applicable to articles or specimens of various shapes provided the material does not contain a high proportion of extractables. If so, specimens of identical size and shape from both the tensile sheet and the product are necessary.

(3) Hardness. Fairly sensitive to state of cure but also dependent on shape and size of specimen.

(4) Stress-strain, modulus at low extension, ultimate tensile and elongation. Modulus and breaking elongation are very sensitive to state of cure and in some cases tensile strength also. However, all are influenced by the geometry of the sample and if buffing is required both ultimate tensile and elongation are affected. Of these properties, modulus at a low extension is probably the best choice.

(5) Set properties. Compression set, tension set, creep and stress-relaxation are all sensitive to state of cure. Compression set may be determined by plying up discs cut from tensile sheets, and if a standard specimen or discs which may be plied up to ½ inch thickness can be obtained from the article, a good comparison can be obtained. The usefulness of the other tests depends on the possibility of obtaining suitable test specimens.

(6) T-50 test. This test is sensitive to state of cure for natural rubber products and requires a specimen of specific shape. It is not applicable to other elastomers.

F. S. Conant J. F. Svetlik A. E. Juve

THERMAL DIFFUSIVITIES (IN.²/MIN.) OF RUBBER COMPOUNDS REPORTED IN THE LITERATURE

Reference	Hevea		Butadiene-Styrene	Butadiene-Acrylonitrile	Neoprene	Butyl
	Tread	Gum				
1	.00613 to .0015	.0064	——	——	——	——
2	.0102	——	.0115	.0115	.0102	.00836
3	.00465 to .0093	——	——	——	——	——
4	.00743 to .0130	——	——	——	——	——
5	.00912	.00938	——	——	——	——
6	.0131	——	.0152	——	——	——
7	.0094	.0062	.0063	.0080	.0067	.0053

Note: Thermal diffusivity values increase with increased pigment loading and decrease with increasing temperature.

References: (1) Williams, Ira, *Ind. Eng. Chem.*, Vol. 15, p. 154 (1923); (2) "Handbook of Chemistry and Physics," 39th Ed., Chemical Rubber Publishing Co., Cleveland, Ohio, p. 1485 (1957); (3) Hahn, Stuart H., *J. App. Phys.*, Vol. 12, p. 12 (1941); (4) Barnett, C. E., *Ind. Eng. Chem.*, Vol. 26, p. 303 (1934); (5) Cuthbert, C., *Trans. Inst. Rubber Ind.*, Vol. 30, p. 16 (1954); (6) Morris, Ross E., Hollister, Joseph W., and Mallard, Paul A., *Ind. Eng. Chem.*, Vol. 36, p. 649 (1944); (7) Rahmer, John, Jr., *J. Polymer Sci.*, Vol. 2, p. 263 (1947)—Values given are interpolated to correspond to 260°F.

ASTM COMMITTEE WEEK

Committee D-11 Meets
Ozone Symposium Held
D-24 and E-1 Report

► Several important achievements were recorded by Committee D-11 on Rubber and Rubberlike Materials of the American Society for Testing Materials during ASTM Committee Week in St. Louis, Missouri, last month. D-11 subcommittees held meetings on February 10, 11 and 12 and the general meeting was held on February 12. The D-11 dinner, which has become an important social portion of these meetings, was held at the Hotel Statler on the evening of February 11.

A highlight of the D-11 meeting at St. Louis was a Symposium on Ozone Testing, organized by Gus Maassen (Vanderbilt) and a special committee. It was generally agreed that this was one of the finest symposiums presented before the group and full details covering the several papers presented appear elsewhere in this issue.

Dinner Meeting Held

Approximately 60 members and guests attended the D-11 dinner which was held on Tuesday evening, February 11, with Simon Collier (Johns-Manville), division chairman, presiding. After extending a warm welcome to those present, Mr. Collier expressed the thanks of the entire division to Gus Maassen (Vanderbilt) for his work and that of his special committee in organizing the Symposium on Ozone Testing.

John Allen (Firestone), division secretary, reported that the Finance Committee, consisting of himself as chairman and Ian Patterson (Goodyear) and Arthur W Carpenter, had recommended to the Advisory Committee that D-11 be permitted to seek voluntary contributions of $2.00 each from all members of the committee. Approval for such solicitation, which will enable Committee D-11 to move more freely when accruing any necessary expenses, such as participation in the forthcoming International Rubber Meeting to be held in Washington, D.C., in 1959, was granted by the ASTM Advisory Committee.

It was also reported that headquarters will make a special effort to have the new edition of "ASTM Standards on Rubber Products" available by the next meeting and, further, to issue this compilation on an every-other-year basis. The next meeting will be held on June 25-27 at the Statler Hotel in Boston.

Subcommittee Reports

In all, 21 subcommittees met during the St. Louis meeting and presented their reports, all of which were approved by D-11. In addition, R. D. Stiehler (NBS), chairman of the delegation at the recent ISO conference in Zurich, Switzerland, presented a report on activities at that meeting. Elsewhere in this issue there appears a full report on the ISO/TC-45 Zurich meeting. The 21 subcommittee reports, as well as a special report of Technical Committee A on Automotive Rubber, follow herewith:

Subcommittee 5—Wire and Cable (J. T. Blake, Simplex Wire & Cable, Chairman): This subcommittee voted to put the following changes through a retroactive letter ballot and the E-10 procedure so that they may be in the June edition of the D-11 compilation: (1) Revised tables 1 and 2 in D-1350; (2) New specification for an insulation on a conductor operating at 90°C, and (3) A change in scope limiting the insulations of D-27, 353, 469, 754 and 755 to 2000 volts. There was much discussion on the scope of the Subcommittee 5 assignment and a modification will be forthcoming. It was voted to recommend the advancement of eight specifications from tentative to standard including D-27, 353, 469, 754, 755, 532, 574 and 866.

Subcommittee 6—Packings (R. F. Anderson, Chairman): Tentative standards were reviewed and the following recommendations made by the subcommittee: On D-1081-49T, "Tests for Evaluating Pressure Sealing Properties of Rubber and Rubberlike Materials," it was reported that the Bureau of Ships is developing a modified procedure. It was recommended, therefore, that this procedure be held as a tentative. On D-1147-56T, "Tests for Compressibility and Recovery of Gasket Materials," a working group was assigned to revise Table I of this method so as to conform with the description of materials and conditioning procedures established by the revised D-1170 Gasket Specification. The recommendations of the working group will be letter balloted in the subcommittee. In view of the pending revision, it was recommended that this method be held as tentative. As to D-1330-55T, "Specification for Sheet Rubber Packing," an editorial change was approved to correct a printing error in Table I. On line 1, "16" is to be changed to the word "in". Due to the limited usage of this method, it was recommended that it remain tentative.

It was suggested that a footnote be added to D-1081 to show where the Seal Aging Jigs may be obtained. This will be investigated by the chairman. The committee scope was reviewed. It was agreed that the scope as previously submitted was satisfactory. It reads: "Development of Specifications and Methods of Test Applicable to Packings".

Stress Relaxation Reports

A report was given on the status of the Stress-Relaxation Round-Robin underway in Subcommittee 10c of Tech A. A progress report on the sealability work in 10c of Tech A was made. A working group on corrosion has been appointed by 10c of Tech A. They will meet in Detroit to study the possibilities of developing a corrosion procedure for gasketing material. Mr. Chatten of the New York Naval Shipyards reported that an O-ring specification will be issued shortly by the Navy. It will include a stress-relaxation requirement.

Subcommittee 8—Nomenclature (R. G. Seaman, Rubber World, Chairman): The draft definitions for ISO Recommendations, International Organization for Standardization Recommendations Nos. 48-53, of ISO Working Group 5—Terminology of ISO Technical Committee 45—Rubber in ISO(RUC)2237, dated June, 1956, were discussed. The draft definitions in this document are repeated below together with the recommendations of ASTM D-11, Subcommittee 8 in this connection.

(1) Abrasion resistance index—Measure of the abrasion resistance of a natural or synthetic rubber relative to that of a standard rubber in specified conditions and expressed as $\frac{S}{T} \times 100$, where S is the volume loss of a standard rubber, and T is the volume loss of the rubber under test. This definition was approved by Subcommittee 8.

(2) Tear strength—Maximum load applied in the course of tearing in two a specified test piece, the load acting in a direction substantially parallel to the major axis of the test piece. Subcommittee 8 recommended the use of the word "apart" instead of "in two" in the first part of this definition and, more particularly, recommended that the force in pounds per inch or of unit thickness of the specimen required to tear the sample, be indicated. This is in conformity with the definition of tear resistance as it appears on page 103 of ASTM Special Technical Publication No. 184, "Glossary of Terms Relating to Rubber and Rubberlike Materials".

(3) Hardness—Resistance to indentation. Subcommittee 8 is in agreement with this definition of hardness.

(4) International rubber hardness degrees—Measure of hardness the magnitude of which is derived from the depth of penetration of a specified indentor into a test piece in specified conditions. The scale is so chosen that 0 degrees would represent a material showing no measurable resistance to indentation, and 100 degrees would represent a material showing no measurable indentation. The scale is completely described in ISO Recommendation No. 50. The only suggestion here is replacement of the word "in" by the word "under" between the words "test piece" and "specified" in the first sentence.

(5) Mechanical stability (of natural rubber latex)—Property measured by the time in seconds required to produce specified evidence of clotting when latex is stirred under specified conditions. It is suggested that the parenthetical "of natural rubber latex" be eliminated so that this definition will apply to all latices. It is also suggested that the definition be changed to read as follows: "Resistance to clotting of latex when subjected to mechanical shear under specified conditions."

(6) Grain—Uni-directional orientation of rubber or filler particles resulting in anisotropy of a material. Subcommittee 8 agrees with this definition as it stands; (7) Swelling—Increase in volume or linear dimensions of a test piece immersed in a liquid or exposed to a vapor. Subcommittee 8 agrees with this definition as it stands; (8) Tensile stress—A stress applied so as to stretch the test piece; numerically it is the applied load divided by the area of the initial cross-section. Subcommittee 8 agrees with this definition as it stands.

(9) Tensile stress at a given elongation. (modulus deprecated) — The tensile stress required to stretch the test piece from the initial condition to the given elongation. Note that the term "modulus" is deprecated because of the confusion which has arisen through the use of this term to denote the above as well as the slope of the stress-strain curve at a given elongation. Subcommittee 8 agrees with this definition as it stands.

(10) Tensile strength — The maximum tensile stress applied uniformly over the cross-section of the test piece in the course of stretching the test piece to rupture. Subcommittee 8 agrees with this definition as it stands, and (11) Test piece—A piece of material appropriately shaped and prepared so that it is ready for use in a physical test. Subcommittee 8 suggests modification of this definition to include the word "specimen" instead of "piece" and "material" defined as that actually tested.

This subcommittee plans to develop tentative recommended practices for elastomer terminology based upon material in the ASTM "Glossary of Terms" mentioned above and from other sources. Emphasis will be given to terms in which ISO/TC-45 is interested.

During the course of the meeting L. V. Cooper presented definitions for rubberlike materials and vulcanization for consideration by Subcommittee 8 as revisions of the definitions in the present ASTM Special Technical Publication No. 184 "Glossary of Terms relating to Rubber and Rubberlike Materials" and for eventual adoption as Tentative Recommended Practice for Nomenclature for Elastomers. These definitions are as follows:

"A rubberlike material is one which in the normally compounded state and vulcanized or polymerized produces a product with elastic characteristics which will recover its original size and shape within 5 per cent in less than 3 seconds when (1) compressed to ¾ of its original thickness for 5 seconds and released, or (2) elongated to double its length for 5 seconds and released."

"Vulcanization is a reaction in which the physical properties of an elastomer are changed in the direction of decreased plastic flow and increased elasticity."

This subcommittee recommended that these definitions be submitted to letter ballot in Committee D-11 for adoption as Tentatives.

Subcommittee 9—Insulating Tapes (C. W. Pickells, Consolidated Edison, Chairman): The chairman reported that the

George E. Martin

Theodore Kahan

Martin and Kahan Elected Vice-Presidents

► Aldan Rubber Co., Philadelphia, Penna., has announced that George E Martin and Theodore Kahan have been elected vice-presidents of the company. Mr. Martin heads the Technical Sales and Service Division and Mr. Kahan is in charge of Research and Development. Mr. Martin was formerly technologist in charge of coated fabric development for the Army Quartermaster Corps Research Laboratories. He is a graduate of the Philadelphia Textile Institute and holds memberships in the American Association of Textile Chemists and Colorists, and the American Chemical Society. Mr Martin is on the Coated Fabrics Committee of the American Society for Testing Materials and the Industry Advisory Committee on Coated Fabrics for the Department of the Army. Mr. Kahan joined Aldan in 1944 and previously was a control chemist for the Rapid Roller Co. He is a graduate of the University of Chicago and is a member of the Philadelphia Rubber Group and the American Chemical Society.

revisions of D-69, Friction Tape; D-119, Rubber Tape, and D-1373, Ozone Resistant Rubber Tape, which had been recommended to Committee D-11, have been published in the 1957 Supplement. The subcommittee decided to submit several suggested revisions proposed by the Test and Specifications Sections to letter ballot within the subcommittee.

A progress report was made on the work of the task group of which Dr. Frick is chairman, on the preparation of a moisture resistance requirement for rubber tapes. Comparative tests of various rubber tapes and ozone resistant rubber tapes have been made in several laboratories. The data from these tests will be in the hands of the task group chairman shortly for inclusion in a report to be presented at the June meeting. It is intended that a separate specification for moisture resistant rubber tape be written, rather than add a moisture resistance requirement in the present specification.

A proposal to increase the ozone concentration in D-1373, Ozone Resistant Rubber Tape, from .010—.015 per cent by volume to 0.25—.030 was not approved. If tape, capable of withstanding the higher concentration is required, a separate specification will be written.

Subcommittee 10—Physical Testing of Rubber Products (L. V. Cooper, Firestone, Chairman): A. E. Juve, chairman of a task group, presented an excellent write up on "Determination of Equivalent Cures in Specimens of Various Shapes." This report covered a much needed method and those present were so impressed that the chairman was instructed to see to it that widespread publication be implemented as soon as possible.

Dr. Stiehler, substituting for Mr. Tener, presented the Bureau of Standards report on tension testing of O-rings. As a result of this report the subcommittee voted to ask for the elimination of D-1414 and instructed the chairman to make the necessary editorial changes in D-412 so as to properly include the testing of O-rings under the paragraph on the testing of ring specimens. Dave Scott reported on the calibration of testing machines and stated that the problem was of considerable magnitude and that much conflicting data had been received. His problems had been taken up with the D-11 Advisory Committee who had instructed the subcommittee chairman to consult Subcommittee 1 of Committee E-1.

The subcommittee chairman, along with Mr. Scott, attended a meeting of Subcommittee 1 of Committee E-1 and presented the problem. The chairman of this subcommittee requested that Subcommittee 10 of D-11 present their request in writing and recommend members of Subcommittee 10 who will cooperate with members of D-6, D-13, D-20 and E-1 in formulating a possible method of calibration.

The subcommittee instructed the chairman to comply with the request and recommended to D-11 that Mr. Scott and Mr. Tangenberg be certified to Subcommittee 1 of Committee E-1 for this task group.

Subcommittee 11—Chemical Analyses (W. P. Tyler, Goodrich, Chairman): Mr Maassen explained the status of two rubber chemical methods currently being studied. One method, a proposed method of solubility determination was discussed and sent back to the task group for editorial revision. The other method is in the "information only" stage. Changes in D-297 were discussed relating to copper determination. A task group will make a short study of a change proposed to bring the method into line with ISO/TC-45 method before balloting on the change. A task group has been formed to study editorial changes necessary in D-833. A progress report on sulfur determination by two methods was given by Mr. Jacobs. Both methods look promising but more study of the results is necessary to find the reason for certain trends observed. A brief discussion of testing progress results on zinc determination and on rapid reflex extraction methods was held. More work on both studies will be carried out.

Subcommittee 12—Crude Natural Rubber (Norman Bekkedahl, National Bureau of Standards, Chairman): A report was given by Dr. Stiehler on the accomplishments of the ISO meeting held this past September in Zurich, Switzerland. Subcommittee 12 recommended that ASTM accept the following ISO procedures for crude natural rubber: Sampling, determination of volatile matter, ash, copper, manganese, dirt, and rubber hydrocarbon content. It was also recommended that these methods, along with ASTM's present methods for acetone-soluble materials and iron, be submitted to D-11 letter ballot, and that these methods be placed under a single designation, entitled "Methods of Chemical Analysis of Natural Rubber", and replace the present D-1278-53T, which is "Test for Harmful Dirt in Crude Natural Rubber." It was also recommended that Subcommittee 12 study rapid methods for the determination of deterioration of crude natural rubber and also methods of physical testing, friction ratio on mill rolls, etc. Dr. Stiehler also reported that the National Bureau of Standards now has a standard sample for natural rubber which is exceptionally uniform.

Subcommittee 13—Synthetic Elastomers (B. S. Garvey, Jr., Sharples Chemicals, Chairman): It was announced that the new numbers assigned to styrene-butadiene rubbers (SBR) and latices between June 1957, and January, 1958, were published in *Rubber World* and RUBBER AGE and approved by letter ballot in Committee D-11. L. G. Mason reported for Section 1 on sampling. Nothing is being done or will be done for the present on method of sampling for testing mill shrinkage. This subcommittee will continue work on a method of sampling oil and black masterbatches. B. C. Pryor reported for Section 2 on chemical tests for SBR rubbers. Method for Ethanol Toluene Azeotrope (ETA), extract has been approved by letter ballot in Committee D-11. The method for determination of a mixed alkalated phenol antioxidant has been cross-checked within the committee as previously reported with adequate accuracy. Motion was carried to submit this method to letter ballot in Committee D-11.

Mr. Pryor asked for suggestions for methods for determination of oil content and total extract in dry SBR. Section 2 will draw up a proposed method and submit it to Subcommittee 13. Also, a method for determination of an antioxidant in oil masterbatch will be considered. Present ASTM methods for determination of moisture or volatile matter were discussed and explained. The mill method is used by all SBR producing plants for most rubbers because it is faster. The oven method is used only for sticky rubber. The azeotropic distillation method is not used and is not recommended by producing plants.

Wanted:
Comments on New Definitions

► During the meeting of Subcommittee VIII on Nomenclature of ASTM Committee D-11 on Rubber and Rubberlike Products at St. Louis, two new definitions were proposed for inclusion in some forthcoming revision of the "Glossary of Terms." One of these was:

> "A rubberlike material is one which in the normaliy compounded state and vulcanized or polymerized produces a product with elastic characteristics which will recover its original size and shape within 5 per cent in less than three seconds when (1) compressed to three fourths of its original thickness for five seconds and released, or (2) elongated to double its length for five seconds and released."

The second proposal, actually a revision of the existing definition was:

> "Vulcanization—a reaction in which the physical properties of an elastomer are changed in the direction of decreased plastic flow and increased elasticity."

The ASTM subcommittee concerned invites comment on these definitions. Accordingly, it is suggested that comments be sent to the editor of this journal and we will pass the information along to the proper people.

Section 3 on Physical Tests of SBR has been reconstituted with the following committee: W. G. Orr, chairman; W. M. Otto, and A. R. Baker. Mr. Orr reported plans for a survey to be made among producers to determine (1) formulae now being used for each polymer type and recommendations. The sentiment appeared to favor use of HAF black in place of EPC black for oil masterbatches and possibly some other rubbers as soon as adequate data are available. The use of a laboratory Banbury mix as an alternate for laboratory mill mix will be considered as data are available.

The separation of recipes for physical tests on SBR from D-15 method was referred to a group from Subcommittees 29 and 13 with Messrs. Orr, Otto and Baker as representatives from Subcommittee 13. A cross-check of physical tests among producing and consuming plants on standard bales from NBS 386A will be arranged by Mr. Orr. He will also arrange for a blend of 500 pounds of rubber to be sent to plants for cross-check of chemical test results. The Bureau of Standards certifies physical test results only.

I. D. Patterson reported there were no new test methods for SBR latices. Section 4 was asked to be continued subject to call as needed. R. G. Seaman reported results from the D-11 letter ballot to include silicone elastomers by the symbol Si in D-1418 as 113 affirmative and 2 negative. The task group recommended the D-11 vote be allowed to stand, as the reasons for negative votes were not considered sufficient for rejection. Dr. Garvey discharged Section 5 as all matters of nomenclature for synthetic rubbers can be referred to Subcommittee 8. Motion was carried expressing thanks and appreciation to editors of *Rubber World* and RUBBER AGE for publication of ASTM SBR nomenclature and related terms and new numbers.

S. Doner reported that Section 6 had completed its work on reference materials. Therefore, Dr. Garvey discharged Section 6. Mr. Maassen reported that Section 7 had completed its work on decription of styrene-butadiene rubbers in publication of ASTM D-1419 and D-1420. Accordingly, this section was also discharged. Reference testing formula for all new SBR numbers is to be submitted for assignment in D-15.

Subcommittee 14—Abrasion Tests (R. F. Tener, National Bureau of Standards, Chairman): H. G. Bimmerman reported to the subcommittee on the activities of ISO/TC-45 in Zurich, Switzerland concerning the resistance to tear of rubber. The following scope was approved by the subcommittee: The development of methods of test for abrasion, tearing and cutting resistance of rubber and rubberlike materials. A proposed revision of D-394 and a proposed standard for resistance to abrasion of soles and heels were approved for submission to letter ballot of the subcommittee.

Subcommittee 15—Aging (G. C. Maassen, R. T. Vanderbilt, Chairman): It was voted that Method D-1206-52T be kept on a temporary basis pending results of work being done at the National Bureau of Standards. It was also voted that Method D-1149-55T be kept on a temporary basis because of changes in the method presently being evaluated. A motion was also carried that Methods D-749-43T and D-750-55T be kept on a temporary basis until such time as a satisfactory method for calibrating the light source is evolved. Work is now in progress.

A. G. Veith, chairman of Task Group 5 of Subcommittee 15 gave a report on the inter-laboratory ozone test program sponsored by that group. (Editor's Note: A full report on Mr. Veith's paper appears elsewhere in this issue). It was voted that a committee comprised of members of Subcommittees 5 and 15 and Committee D-20 should be established to investigate and to develop ways and means for aging uniformly, polyvinyl chloride and other compositions containing substantial (high) amounts of plasticizers.

Subcommittee 17—Tests of Hardness, Set and Creep (S. R. Doner, Raybestos-Manhattan, Chairman): S. Collier asked all subcommittees to submit a scope of their activities. It was agreed that the following should be suitable for this subcommittee: "Formulation of methods of test for the hardness, compression set, and creep or stress-relaxation characteristics of rubber and rubberlike materials". It was moved and seconded that ASTM, D-314-52T be advanced to standard. There are some errors in ASTM D-1415-56T which have come to 17's attention. It was agreed that these should be corrected and a vote of Committee D-11 should not be necessary. The corrections are as follows:

In the next to the last paragraph of the foreword, the value "1.37" should be "1.367" and "300 psi" should be "331 psi". In the last paragraph, "which equals" should be "is equal to".

Apparatus: 2(a) Change "2.44±0.06 mm" to "2.38 or 2.50±0.01 mm". Balls 2.44 mm in diameter are not available and the method originally intended that with 2.38 or 2.50 mm balls should be used. 2(b) Rewrite the first paragraph as follows: "Load Applicator for applying loads of 30±1g" and "564±2g to a 2.38 mm ball or 580±2g to a 2.50 mm ball." 2(d) Change "500 and 600" to "600 and 900".

5(b) Change next to the last sentence to read "Apply an additional load of 534 or 550g±1g depending on the size of ball on the indentor and maintain it for 30 sec. (Note)".

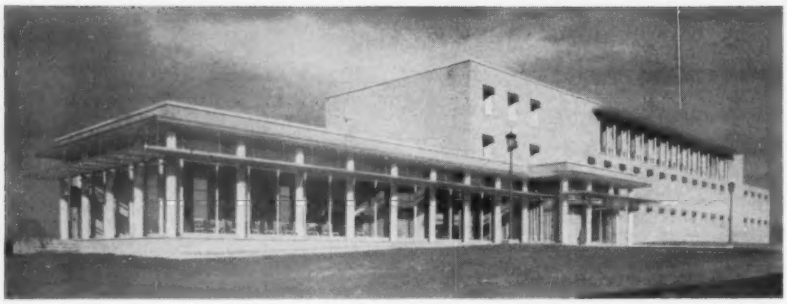
D-395-55 Compression Set. A questionnaire will be circulated to determine whether some work should be done toward allowing the use of a molded compression set specimen as well as a cut specimen. The chairman will handle this matter.

D-676-55T Indentation of Rubber by Means of a Durometer. A questionnaire will be circulated by the chairman regarding the advisability of conditioning the Durometer in a dessicator at low temperature for low temperature hardness determinations.

ISO Draft Proposal for the Determination of Compression Set. CX(RUC) 9761 October, 1957. It was agreed that a negative vote should be registered on this method. On the basis that the subcommittees do not agree, the surfaces of the test specimen should be lubricated with silicone oil.

Testing Machines Opens New Quarters

► Testing Machines Inc., have recently announced the opening of their new and expanded facilities at 72 Jericho Turnpike, Mineola, L. I., N. Y. In air conditioned showrooms and offices, and with enlarged facilities for manufacture, repair, maintenance and calibration, Testing Machines can offer faster and improved service to its many customers. A new department has been opened for the custom designing of new instruments and for the special modification for testing instruments that are not ordinarily handled through standard methods. A special department has been established to purchase and sell used and reconditioned equipment with the T.M.I. guarantee. T.M.I. also maintains files listing equipment available from many sources of supply. Company officials said the new facilities will be of special interest to all who wish to have a new idea developed or a prototype model produced, marketed and serviced.



Grace Opens Washington Research Center

► W. R. Grace & Co., New York, N. Y., has completed the first of two main laboratories near Clarksville, Md., at which research activities of the Davison Chemical Division and the Grace Research and Development Division will be consolidated. This first unit of the $5 million Washington Research Center is 55 thousand square feet in area and houses about 160 people, mostly chemists, physicists, engineers and technicians who are engaged in inorganic research, largely in the fields of catalysts, silicas and agricultural chemicals. Formal dedication of the building will take place this spring.

A second laboratory to be located on the 150 acre site has been designed to provide facilities principally for organic research in the fields of polymers, petrochemicals and chemical intermediates. When this new building is completed, it will provide 42 thousand square feet and house a nucleus of professional and technical personnel from the Grace Research and Development Division, now located temporarily at Clifton, N. J., and at a laboratory in New York City. Completion is expected in the summer of 1958.

W. P. Gage, president of the Grace Research and Development Division, will be responsible for over-all management of the Center, which will be under the direct supervision of Dr. D. L. Fuller and Dr. P. L. Veltman.

Subcommittee 19—Rubber Materials in Liquids (W. N. Keen, Chairman): The following matters were discussed at this meeting: (1) Methods D-471-57T, D-814-55 and D-1460-57T were agreed to be satisfactory at this time; (2) A report was read from H. G. Bimmerman, representing the United States at the ISO/TC-45 meeting in Zurich. It was felt that decisions reached at that meeting were in keeping with Subcommittee 19's wishes. The revised Document 238 will be circulated within the committee for comment when received;

(3) Task Group A asked to be relieved of its assignment to determine the adequacy of D-471 at test temperatures of 300°F. Upon subcommittee vote, it was agreed to request a detailed report from Task Group A for circulation to the committee before a decision is reached; (4) Mr. Kapps (F. D. Farnam Co.), requested a statement of policy regarding the committee's attitude toward test fluids representative of new automotive fuels. Subcommittee 19 is following the progress of work toward this end in Subsection 4H of Tech A and will consider the matter at a later date.

Subcommittee 20—Adhesion Tests (H. H. Irvin, Marbon Corp., Chairman): It was moved by J. H. Macey and seconded by D. C. Scott, Jr., that the following scope for this subcommittee be put to letter ballot: "The development, preparation and standardization of test methods whereby accurate values of bond strength between elastomers and rigid materials can be determined." Development of actual specifications from tests such as D-429 are to be resolved by D-11. It appears to call for participation with other groups. Mr. Macey and P. J. Larsen were asked to prepare written comments on the expansion of current test methods to include the possibility of determining environmental effects on bond strength. Messrs. Macey and Frye reported on the status of non-destructive and dynamic test methods. It was concluded that no appreciable progress has been made in these areas.

R. Stiehler, reporting on TC-45 acceptance of our comments re ISO Draft Proposal 323 (Our D-429 equivalent) said that he believed that TC-45 had met our objections to Part A, and that a soon to be published report would confirm this. Part B is to be studied further by the working group. It was moved by Mr. Macey and seconded by Mr. Scott that D-429-56T be advanced to standard. Motion was adopted and said recommendation is made to D-11.

It was moved by H. Tangenberg and seconded by J. J. Allen that D-413-39 be continued as standard, there being no adverse comment by the subcommittee membership. Clarification of Subcommittee 20's jurisdiction over D-413 is, however, sought from D-11 in view of the proposed scope to limit Subcommittee 20 to test methods for bonded assemblies in which one component is rigid.

Following a request of the chairman of Subsection 4W of SAE-ASTM Technical Committee A to comment on their activities in setting K values, it was agreed that Subcommittee 20 would ask for representation on this subsection to better appraise the problem.

Subcommittee 21—Cements and Related Products (J. F. Anderson, B. F. Goodrich, Chairman): In accordance with a letter from Committee D-11's secretary dated November 14, 1957, action was taken with reference to test methods under jurisdiction of Subcommittee 21. It was voted to advance D-1205-53T to standard. There is no change in D-553-42. Alternate method D-927-55T, Shearing Disc Viscometer, was approved for incorporation in D-11 methods at the annual meeting in 1957. A footnote to this effect in D-553-42, was recommended.

After a review of nondestructive test developments of recent years, the meeting was turned over to Clark Lupton who discussed the progress of his task group working on a method of non-destructive test using the Magnaflux Sonizone apparatus. Mr. Lindgren assisted Mr. Lupton in describing the use of the instrument. The task group will prepare a written procedure in ASTM form based on the method written for this meeting. This should be ready for approval by the committee by May 1, 1958. (D-1205-53T).

Further work on the Disc Shear test is being delayed pending changes in the equipment and method of preparation of samples (D-1205-53T). F. A. Obstfeld brought to the attention of the subcommittee the need for a reliable rubber to cord adhesion test. After investigation of methods available, in addition to the H-Test, a task group will be organized to study this problem. Subcommittee 8 might help in defining "adhesives" and "cements."

Subcommittee 22—Cellular Rubbers (H. G. Bimmerman, Chairman): Mr. Wohler had previously sent in his report on the indentation test for latex foam. Dr. Yoran agreed with his suggested changes. The changes suggested were discussed in detail and decisions reached which were essentially as recommended. These will be letter ballotted in D-11. They are (1) apparatus employs ball and socket joint except where testing flat stock when it is not required; (2) speed of deflection 0.5 to 25 inches per minute; (3) thickness of specimen no less than ¾ inch; (4) specify location of indentor foot, and (5) clarification of preload and reading time. These changes will bring ASTM and RMA methods into closer agreement.

Mr. Taylor again discussed the variation in results obtained with various indentation machines. He will confer with Mr. Barnes and Mr. Svendsen on means of obtaining better correlation and report at the next meeting. Mr. Barnes stated the need for a better test for this foam sample. The indentation test, although used, is not reliable on these thinner specimens. The chairman was requested to prepare a note on safety precautions to be taken when aging cellular products.

Mr. Johnson of Sun Rubber reported on aging results he had obtained on urethane foams and stressed the need for accelerated aging methods which would

correlate with natural aging. A. F. Sereque presented a draft of test methods and specifications for closed cell vinyl sponge. These were discussed and SPI will again revise them based on comments which have been received. The latest revision of the vinyl foam methods dated December 21, 1957, had been sent to the subcommittee. It agreed that these should be letter ballotted in D-11.

Mr. Barnes presented the latest urethane foam methods as prepared by SPI under date of February 6, 1958. These were reviewed in considerable detail and certain revisions suggested. He will submit a corrected copy for letter ballot in D-11.

Subcommittee 23—Hard Rubber (W. J. Dermody, Stokes Molded Products, Chairman): Standards D-530, D-639 and D-1484 are now on a tentative basis as approved by the Society in 1957 and this subcommittee recommends that they be so continued. The chairman reported for J. R. Smyth, Task Force 1, on Impact. Several suggestions for incorporation in the next round-robin were received from the floor and will be forwarded to Mr. Smyth for action. There was no report from Task Force 5 on Water Absorption which was the only other task force scheduled for report.

R. Wentland reported in detail on standardization of methods with Committee D-20 on Plastics. Subcommittee 1, Section Q of D-20 is now reviewing Standards D-676(55-T) Indentation of Rubbers by Means of a Durometer, and D-1484 (57-T) Penetration of Hard Rubber by Type "D" Durometer, to determine their suitability for use in the testing of plastics. (D-676 is not under the jurisdiction of Subcommittee 23).

Standard D-639 has recently been completely rewritten editorially by the ASTM staff to bring the format up-to-date and the necessary changes have been incorporated in the 1957 revision. It is recognized by this subcommittee that a similar revision of D-530 would be most desirable but that a considerable amount of standardization of methods, specimen conditioning and testing conditions is first required. Preliminary work on this will be undertaken in advance of the June meeting.

The scope of Subcommittee 23 was reviewed and is stated as: "Development, evaluation and standardization of test methods, classifications, definitions, specifications and recommended practices for rigid or near rigid vulcanizates of unsaturated elastomeric polymers, including research investigations of the engineering properties of these materials." (Asphalt composition and battery containers, have, through usage, been considered also to be within the scope of this subcommittee). British Standards received through the Society during 1957 were noted for record.

Subcommittee 24—Rubber and Rubber-like Coated Fabrics (K. L. Keene, U. S. Rubber, Chairman): The following action was taken by this subcommittee: (1) It was voted to retain D-751-57T as a tentative due to further work; (2) It was voted to retain D-815-47 as a full standard; (3) The results of a subcommittee letter ballot on the changes proposed for the section of D-751-57T pertaining to "Bursting Strength" were read. There were 27 affirmative, 0 negative and 4 not voting, ballots cast. This represents 100 per cent of the committee. It was recommended that this change in the Bursting Strength Method be submitted to a letter ballot of Committee D-11; (4) Subcommittee 15 was requested to report to this subcommittee any progress on their work on the study of air circulation in ovens used for aging tests, and (5) Committee D-9 requested information on a better way of testing silicone coated fabrics for tensile strength.

Subcommittee 25—Low Temperature Tests (R. S. Havenhill, St. Joseph Lead, Chairman): Reported on at this meeting was the following: ISO Low Temperature Hardness—R. D. Stiehler reported that possibly both low temperature hardness and modulus could be obtained with the ISO (Wallace) dead weight hardness instrument equipped with the new liquid nitrogen chamber. He will try to have a report ready for the next meeting;

ASTM D-832-56T (Conditioning Procedure)—It was agreed to keep this method tentative in view of possible future changes; ASTM D-736-54T (Brittleness)—In the note under Apparatus 2(a) it was agreed to change the —65°F. to —67°F. to make the method conform to the recent change in D-735; ASTM D-797-46 (Young's Modulus) — Under Procedure 4(a) lines 5 and 7 also 4(c) line 4, it was agreed to change the 70°F. to 73°F. Under Procedure 4(d) change —70°F. to —67°F. and +70°F. to +73°F. This makes the method conform with test temperatures recommended in D-1349-54T;

ASTM D-1053-54T (Torsion Wire Stiffness) — The chairman reported no negative votes on the D-11 letter ballot on the recent revision of this method. A few editorial changes were agreed upon which will make the method conform with the ISO method. It was recommended that a few changes be made in the proposed ISO method and that the *go no go* provision be included;

ASTM D-1329-54T (TR Test)—Since there were no negative votes in the D-11 letter ballot, the revised method is ready for inclusion in the new standards book;

ASTM D-746-55T (Brittleness Test)—Robert G. Dunlop, chairman of the committee to determine the speed of the Scott Solenoid using the ball thrust method, reported good duplication of results by Rock Island Arsenal. He also reported that the procedure should be modified to start

A SURVEY:

Tubeless vs. Tubed Tires

► In an attempt to shed some light on the continuing controversy between tubed and tubeless tires, the editors of *Popular Mechanics* recently surveyed hundreds of motorists and tire repairmen all over the country. The results of this survey, published in the December, 1957, issue of *Popular Mechanics*, indicated that most automobile owners approve of tubeless tires. As in most other areas of human behavior, however, the dissatisfied user is the vocal user, while the satisfied motorist rolls along without saying much about his tubeless tires.

According to the survey, 71 per cent of the motorists questioned prefer tubeless tires. Furthermore, 84 per cent indicated that tubeless tires gave less trouble than tubed tires. Generally speaking, tire repairmen are much more critical of tubeless tires than the motorists themselves Tire repairmen, in stating personal preferences for their own cars, show a slight margin in favor of tubed tires. The actual figures show that 50 per cent preferred tubed tires; 47 per cent preferred tubeless, and 3 per cent preferred a combination of a tubeless tire with a tube added.

The survey showed that motorists have two definite likes in regard to tubeless tires — the fact that most punctured tires won't go flat immediately, and the fact that they require fewer repairs. While tire manufacturers have emphasized that tubeless tires run cooler in hot weather, only 6 per cent of the motorists questioned mentioned this point.

Of the 29 per cent of the motorists who report tubeless tire dissatisfaction, the biggest complaint was the difficulty in obtaining proper service. Motorists who reported blowouts with tubeless tires were asked to describe the circumstances. Surprisingly, in more than half the cases, temperature was not a factor. However, almost half the blowouts occurred at speeds of 60 mph or higher.

Tire repairmen in general felt that tubeless tires give motorists more trouble than tires with tubes. Seventy per cent of the repairmen questioned listed slow leaks as the most frequent cause of trouble. The same percentage stated that they have more complaints of tire thump with tubeless tires. Fully 91 per cent say that they have recommended, at one time or another, that motorists install tubes in tubeless tires for reasons ranging from leaks that can't be found to peace of mind for the customer. The survey also reported that almost every repairman recommended two to six pounds higher pressure for both front and rear tires than the manufacturer specified.

ball with solenoid rather than to impact it, and balls of different diameter should be tried.

The chairman's report on the specimen questionnaire showed that 60 per cent used the ¼" width with parallel sides, 40 per cent used the narrow (.075" to .125") specimen. Since 77.6 per cent of those using the narrow specimen used the modified T50 specimen (.1" width with ¼" tab on one end), it was agreed to incorporate this in place of the T50 specimen and include a line drawing of the die; ISO/TC-45 Meeting in Zurich, Switzerland—The chairman reported on the progress made on low temperature tests and stated that draft ISO proposals on methods similar to D-746 and D-1053 had been approved.

Subcommittee 26—Processibility Tests (R. H. Taylor, Scott Testers, Chairman): Four items of business were discussed at this meeting, namely: (1) After a brief discussion of a scope for Subcommittee 26, the chairman was authorized to recommend to Committee D-11 the following: "The development of test methods for the evaluation of processibility of unvulcanized rubber and rubberlike materials and for the evaluation of curing characteristics of vulcanizable materials as indicated by changes in viscosity." (2) Mr. Wolczynski, chairman of Task Group 1, appointed to investigate rotors, reported that the planned work had been completed, but some differences indicated insufficient attention was paid to worn rotors. Rechecks will be made before a final report is written.

(3) Mr. Shearer, chairman of Task Group 2 appointed to combine D-927 and D-1077, reported on progress. It was pointed out that the Task Group needed clarification of several points. Some of these were the thermocouple design, speed tolerances, sample preparation, the use of protective films and whether the temperature time curve should continue to be required. The advisability of combining the two methods was also discussed. To aid Mr. Shearer and his group in resolving these problems, G. Decker and E. B. Storey were appointed as additional members; (4) J. S. Sweely, chairman of Task Group 3 appointed to recommend additional methods for evaluating processibility, gave a very comprehensive report with recommendations for work in four fields. These were: shrinkage, roughness, plasticity and extrusion.

After considerable discussion of each item, the subcommittee authorized the appointment of two task groups. These were: Task Group 4—J. Kersher, chairman, and the Messrs. Susie, Garvey, Jr., and Obstfeld to standardize extrusion test dies and methods; Task Group 5—F. J. Sackfield, chairman, and the Messrs. Susie, Storey, Barlow, Otto, Messenger, Black and Sweely on shrinkage.

Subcommittee 27—Tests of Resilience (W. A. Frye, Inland Manufacturing, Chairman): The current methods for Yerzley Resilience (D-945-55) and Impact Resilience (D-1054-55) were discussed. The future possibilities of urethane foam resilience tests and standardization of forced vibration testing machines were also discussed. The chairman was authorized to circulate a questionnaire to determine the usage of the various types of resilience tests. G. W. Painter has consented to be secretary of this subcommittee.

Subcommittee 29—Compounding Ingredients (A. E. Juve, B. F. Goodrich, Chairman): Seven negative votes on the proposed method for testing carbon blacks were recorded. Several of these were withdrawn prior to the meeting on the basis of correspondence. The balance of the negative votes were discussed at length and the subcommittee decided that none of them were of sufficient importance or urgency to warrant holding up approval of the method. The subcommittee, therefore, voted to submit the method to the Society as a tentative standard.

It was announced that the Bureau of Standards has now obtained a 28,000 pound lot of standard natural rubber prepared in Liberia and that it will be available very shortly for sale. It was also announced that a standard sample of MBT has been added. A new lot of cold SBR has also been obtained.

The question as to whether or not D-15 should be broken down into two, three, or more individual methods was discussed at some length. It was voted that a task group representing the interests of Subcommittee 13, the carbon black interests in Subcommittee 29 and the general interests in Subcommittee 29 would be formed to consider this problem from all possible angles and make a recommendation at the next meeting.

There was a short discussion on the possibility of a uniform practice in writing compounding recipes containing oil extended polymer and of the problem of specifying a standard laboratory mixing mill, but no action was taken.

Tech A—Report of Technical Committee on Automotive Rubber (H. Tangenberg): The SAE-ASTM Technical Committee on Automotive Rubber was letter ballotted and approved revisions of D-735 and SAE-10-R. This includes: (1) temperature revisions to conform with D-1349; (2) clarifying the use of oven and test tube aging; (3) removing the basic volume change requirements of ASTM No. 1 Oil and adding these to the suffix requirements, and (4) addition of adhesion values. Specification D-1170 on automotive gaskets has been rewritten, letter balloted and approved. The parent societies, SAE and ASTM, are distributing the publicity reviews of the Committee's activities written by J. M. Ball. (Editor's Note: Mr. Ball's report appears elsewhere in this issue).

The Hose Sections are active on military and federal specifications and are working on Freon and Refrigerant hose. In addition to the gasket specification recently revised, the Automotive Gasket, Oil Seal and O-Ring Sections are continuing their activity in this field.

The Rubber Classification Section is cooperating with several groups on a new format of tables and their application to materials specifications. A new polyvinyl flexible foam specification has been proposed by the Sponge Section and is being letter balloted. The new higher aromatic gasolines will necessitate further work on standard fuels and there is considerable activity on new polymers, latex dipped goods and test investigation.

Other activities of interest during ASTM Committee Week included the meeting of Committee D-24 on Carbon Black which met on Wednesday afternoon, February 12, under the chairmanship of Sherman R. Doner (Manhattan Rubber). It was decided during the meeting of D-24 that Subcommittee II on Chemical Tests will submit two new procedures for letter ballot. These are: (1) the sulfur content of carbon black, and (2) the volatile content of carbon black.

Subcommittee III on Optical Methods will submit a new procedure for determination of benzene discoloration by carbon black for letter ballot. Subcommittee I on Physical Testing is continuing work on the Mass Pellet Strength Test. Subcommittee V on Sampling is continuing work on methods of sampling bag and bulk shipments of carbon black.

Committee Week featured still another meeting of interest to the rubber industry. Subcommittee 27 on Low Temperature Testing of Elastomers and Plastics of

Rolla H. Taylor

Promoted By Scott Testers

► The appointment of Rolla H. Taylor as assistant sales manager has been announced by Scott Testers, Inc., Providence, R. I. Prior to joining Scott in 1953 as sales engineer, Mr. Taylor had gained broad experience in the field of elastomeric technology, through some 20 years with the National Bureau of Standards as a rubber technologist. He has been a member of the American Society for Testing Materials since 1942 and has been active in its various committees. At present he is participating in the work of the committee on Rubber and Rubberlike Materials as chairman of Sub-Committee XXVI. Mr. Taylor is a member of the American Chemical Society Rubber Division, the Chemists Club, and the Providence Engineering Society.

Committee E-1 on Methods of Testing met on Tuesday afternoon, February 11, under the chairmanship of R. S. Havenhill (St. Joseph Lead). During the meeting of Subcommittee 27, Lloyd E. Carlson (St. Joseph Lead) reported on a method and a formula for converting hardness readings on instruments such as Shore and Rex to dead-load instrument readings such as ASTM, MLI, etc. The formula takes into account differences caused by permanent set, flow, time and temperature. Arthur Marthens (Bureau of Ships) agreed to make further statistical studies of hardness conversion data to decrease unexplained variance.

At a meeting of Section I on Correlation of Test Methods prior to the meeting of Subcommittee 27, F. Gavan (Armstrong Cork) reported that A. C. Webber's report on brittleness testing was published on page 40 of the January, 1958, issue of the *ASTM Bulletin*. Since this was the last of a series of reports which included hardness, stiffness, and rheological properties, it was agreed that Mr. Gavan would write up the final report comparing the tests and make recommendations regarding their use. This will end the work of this section.

It was also recommended that the task group on rheological creep be made a new section (V) of Subcommittee 27 with membership as follows: L. Boor, chairman, and F. S. Conant, C. K. Chatten and W. E. Scoville. It was recommended that this group prepare a report for publication prior to the June meeting.

Ozone Symposium Well-Attended

D-11 Sponsored Panel Discussion Features Eight Interesting Papers

► During the 1958 Committee Week of the American Society for Testing Materials, held from February 9 to 14 at the Hotel Statler in St. Louis, Mo., Committee D-11 on Rubber and Rubberlike Materials sponsored a symposium on "Ozone Problems." Approximately 250 members attended the symposium which was held in morning and afternoon sessions on February 10. S. Collier (Johns-Manville), chairman of D-11 opened the meeting. G. C. Maassen (R. T. Vanderbilt) served as symposium chairman. The following papers were presented at the symposium:

"Rubber and Its Environment" by A. J. Haagen-Smit, California Institute of Technology, Pasadena, Calif.

"The Study of the Action of Ozone with Polybutadiene Rubbers and the Inhibition of this Action" by E. R. Erickson, Augustana Research Foundation, Rock Island, Ill.

"The Reaction of Ozone with Rubber" by Harold Tucker, B. F. Goodrich Research Center, Brecksville, Ohio.

"Ozone Resistance of Elastomeric Vulcanizates" by Z. T. Ossefort, Rock Island Arsenal, Rock Island, Ill.

"Chemical Antiozonants and Factors Affecting Their Utility" by William L. Cox, Universal Oil Products Co., Des Plaines, Ill.

"Prevention of Ozone Attack on Rubber by Use of Oils and Waxes" by S. W. Ferris, S. S. Kurtz, and J. J. Sweely, Sun Oil Co., Marcus Hook, Penna.

"Comparison of Accelerated and Natural Tests for Ozone Resistance of Elastomers" by G. N. Vacca, Bell Telephone Laboratories, Murray Hill, N. J.

"Quantitative Measurement of Rate of Ozone Cracking" by A. G. Veith, B. F. Goodrich Research Center, Brecksville, Ohio. During the meeting of Subcommittee 15 on Life Tests, ASTM Committee D-11 on Rubber and Rubberlike Materials, Mr. Veith presented another paper on the subject of ozone, this one entitled "Interlaboratory Ozone Test Program." This paper, plus the eight papers presented at the symposium on ozone, will be made up into a booklet for general distribution.

In his paper on the "Reaction of Ozone With Rubber," Mr. Tucker examined the reaction of ozone with unstressed rubber and neoprene by using open cell sponge. In each case the initial rate of adsorption was very high and decreased with the adsorption of ozone. Under conditions of very high humidity, however, there was no falling off in the rate of ozone up-take. The sponge was extracted with acetone and the products examined.

A similar pattern was obtained on solid SBR in a tread-type recipe. Here as the sample was elongated the amount of ozone adsorbed increased until a strain of about 20 per cent was reached. Under the conditions of the test the ozone up-take reached a constant value at this point.

The mechanism of cracking of rubber by ozone is postulated to be by modification of the rubber structure by ozone to yield a material with low elongation. Cracks then develop by failure in tension of this modified rubber. Cracks typical of ozone cracking were produced by curing the surface of rubber compounds much tighter than the interior.

Mr. Ossefort, in his paper on "Ozone Resistance of Elastomeric Vulcanizates," briefly described the general problem of ozone attack on elastomers, means for its prevention, and principal factors affecting ozone resistance. The commercially available elastomers were classified and tabulated in three categories: (1) Inherently ozone resistant; (2) Ozone resistant if properly compounded with an antiozonant not required, and (3) Ozone resistant if properly compounded with antiozonant required.

The degree of ozone resistance available both within and among the various elastomers was described in some detail by the speaker. Several of the factors which affect the efficacy of antiozonant protection in SBR, nitrile, and natural rubbers were indicated and data furnished to support the conclusions.

A method of protecting ozone susceptible elastomers by external application of antiozonant was presented and recent results obtained using this technique were described. The dependence of ozone resistance on proper compounding was emphasized. This has shown that certain rubbers considered to be ozone resistant behave in the expected manner only if proper attention is given to compounding variables.

Mr. Cox, in his paper on "Chemical Antiozonants and Factors Affecting Their Utility," stated that while many materials show some antiozonant effectiveness, the most effective materials reported to date are the N,N'-di-sec.alkyl-p-phenylenediamines. These materials, which are more than 200 times as reactive toward ozone as is the double bond in SBR, appear to function chiefly as ozone scavengers, reacting with the atmospheric ozone before it can attack the rubber.

Ozone Resistance Factors

The ozone resistance imparted to any one polymer by a particular antiozonant will depend upon the structure of the polymer, the antiozonant concentration, the nature and amount of reinforcing agent, the curing system selected, and the presence or absence of waxes and processing oils, he stated. Similarly, the antiozonant requirement of any given stock will depend upon the geometry and the conditioning of the sample, and the nature of the test—including the strain, ozone concentration, temperature, and whether the test is static or dynamic. Only when due consideration is given to all these factors can the maximum results from chemical antiozonants be achieved—the extension of the crack-free life of the rubber article from hours to years.

It was observed in the paper on "Prevention of Ozone Attack on Rubber by Use of Oils and Waxes" by the Messrs. Ferris, Kurtz and Sweely, that addition of the proper amount and type of petroleum wax to rubber will protect the rubber from ozone checking during outdoor exposure. The wax blooms to the surface and forms a film; the degree of protection afforded depends upon the tenacity with which the wax crystals adhere to the rubber, and upon the manner in which those crystals pack together to form the layer. Proper evaluation of anti-checking waxes requires testing in ozone cabinets, with confirmatory outdoor exposure tests. Proper evaluation of anti-checking waxes requires testing in ozone cabinets, with confirmatory outdoor exposure tests.

Some rubbers are more easily protected

than others, and with the same rubber some waxes are much more effective than others. The performance of a wax depends upon its chemical composition, and although two waxes of widely different composition may each provide good protection, very minor changes in the composition of either may seriously impair its anti-checking powers.

Tailoring of an anti-checking wax therefore involves extensive laboratory and field testing to select the proper wax, and rigid control of the manufacturing processes in order to hold composition the same.

Mr. Vacca, in his paper on "Comparison of Accelerated and Natural Tests for Ozone Resistance of Elastomers," summarized data giving an average picture of results obtained in static accelerated ozone versus outdoor exposure tests. At Bell Telephone Laboratories, where most of the work has been done with black stocks, results indicate that correlation is dependent on the base polymer in the stocks under test.

Thus, in polymers which are inherently resistant to ozone, protective systems are very effective and correlation is very good. This has been true of black neoprene stocks and evidence indicates that it may also be true for butyl stocks. With natural, SBR and NB-R rubbers, protection is more difficult and results vary more widely. With the introduction of the newer and more effective antiozonants such as the dioctyl paraphenylene diamines, correlation is much better.

Indoor vs. Outdoor Tests

It has been argued, Mr. Vacca said, that absolute correlation should not be expected since in outside tests there are influences affecting cracking behavior which are absent in the indoor tests. These include sunlight, rainfall and temperature as well as ozone concentration fluctuations. It has been observed that specimens from some stocks exposed in the late fall of the year will go through the following summer without cracking, while specimens from the same stock exposed in late spring will crack in a few days. This probably results from a combination of factors. Low ozone concentration coupled with low temperature greatly reduces susceptibility to crack formation and may provide time for stress relaxation or, perhaps, for the formation of a protective coating through the effects of sunlight activated changes in the surface.

Accelerated Ozone Tests

In the accelerated ozone test, temperature and ozone concentration are carefully controlled and other variables are absent. The test will at least isolate the effect of ozone which alone is responsible for cracking.

Aside from the effect of location and season of the year, there is also the question of the duration of the outdoor exposure to be used as a criterion. This may vary widely as between tires where a four or five year period will suffice and utility or communication wires where periods in the order of twenty years are involved, he concluded.

In his paper, "Rubber and its Environment", Professor Haagen-Smit noted that when rubber products leave a processing plant, they are subjected to mechanical, physical and chemical influences. With a basic understanding of these phenomena, rubber compound formulas may be adjusted so that the finished article can cope with actual everyday conditions. The most bothersome problems with rubber products are associated with their deterioration due to sunlight, and their failure due to the atmospheric constituents—ozone and oxygen, and atmospheric pollutants such as oxides of nitrogen.

Sunlight attacks rubber stocks, developing a non-tacky surface covered with minute, shallow cracks unlike those of ozone. Oxygen in the air slowly attacks stretched or unstretched rubber, destroying its useful properties of elasticity, tensile strength and wear. It does not, however, develop the cracking effects of ozone, which is characterized by knife-like cuts which leave the rubber between the cracks unaffected. In severe cases these cuts penetrate deeply, causing serious damage. Ozone cracks rubber only when the rubber is under strain. There are two types of ozone cracking: (1) static, where there is stretching, but no flexing action, as in automobile windshield seals, and (2) dynamic, where both stretching and flexing occur, as in tires in service.

Ozone is a natural constituent of the air, and is formed from oxygen through the action of ultraviolet rays from the sun. In cities, ozone is often absent or very low, because the very reactive ozone finds many substances capable of removing it from the air. It was, therefore, very surprising that the deterioration of rubber goods in the Los Angeles area was exceptionally fast, and resembled closely that caused by abnormally high ozone concentration. We have established that this ozone is not coming down from the upper atmosphere, but is due to a photochemical oxidation of organic material by sunlight in the presence of oxides of nitrogen. This is the same chemical reaction which is responsible for the Los Angeles smog.

Engineering development and research is presently under way to reduce these obnoxious materials which generate ozone. However, before these studies are converted into practical methods, and before the public and industry are willing to bear the cost, many years may go by. It is, therefore, important to take measures during this intervening time to minimize ozone damage and nuisance as much as possible.

Some of these means consist of the use of additives to the rubber. Other methods prevent the ready access of the reactants to the rubber surface. In recent years great progress has been made in the perfection of these methods. However, revolutionary changes in operating requirements and even changes in our atmosphere require constant alertness if the rubber industry is to cope with problems of modern living.

In his paper on the "Quantitative Measurement of Rate of Ozone Cracking," Mr. Veith stated that there is a movement underway to correct the deficiencies of the present ASTM D-1149-55T test method. These deficiencies are (a) the lack of sufficient air throughout rate and circulation in the presently specified chamber and (b) difficulties encountered in the analysis of ozone. A new chamber and countercurrent ozone absorption column that avoid the above mentioned shortcomings were described.

Discusses Creep Rate

As part of a program to obtain basic information on the phenomenon of ozone cracking, some preliminary results on the ozone induced creep of gum vulcanizates were reported. The creep rate has been expressed in terms of the initial rate of cross-sectional area decrease due to ozone cracking. This rate is a measure of the collective growth of ozone cracks. Induction periods during which no creep occurs have been observed. An "absolute" rate of cross-sectional area decrease can be obtained independently of sample geometry. For practical reasons an approximate "absolute" rate is used where sample geometry is maintained essentially constant.

The rate of cross-sectional area decrease is linearly related to the reciprocal degree of orientation of the network chains, $(\lambda_o F)^{-1}$. The logarithm of the induction period is also linear with $(\lambda_o F)^{-1}$. Explanations for this particular dependence are offered. The rate of crack growth and the induction period for a series of common polymers were measured. Both parameters placed the polymers in the order that experience would indicate and lend confidence to the creep technique, Mr. Veith observed.

Ernest E. Flowers

Named Sales Representative

► Ernest E. Flowers has been appointed sales representative for the J. H. Day Co. Division of the Cleveland Automatic Machine Co., Cincinnati, Ohio, covering Iowa, Minnesota, western Wisconsin and northern Illinois, with the exception of the metropolitan Chicago area. Headquarters will be located in Chicago, Ill. Mr. Flowers has served previously as the J. H. Day sales and service representative in the metropolitan Chicago area and has been with the company for nine years.

In the paper he presented before Subcommittee 15, which met in the morning on February 11, Mr. Veith stated that a program to determine the magnitude of interlaboratory variation in accelerated ozone testing has been planned and carried out by the Ozone Test Station of Subcommittee 15. Samples of typical styrene rubber, neoprene and butyl formulations were mixed and cured at one laboratory and sent out to be tested under the following conditions:

Ozone Concentration	50 pphm
Temperature	120°F.
Exposure Time:	
Styrene Rubber	0.5 hr.
Neoprene	24 hr.
Butyl	100 hr.
Number of Runs	2
Air Changes per Minute	¾
Sample Type	Bent Loop*

*ASTM D-518-44

The relaxed exposed samples were returned to the Goodrich Research Center for evaluation. A technique for measuring the mean crack length was developed and evidence presented to show that this parameter reliably reflects the degree of cracking or extent of attack due to ozone under the conditions of these tests. Two different ozone chambers, the Bush and the Mast, were included in the test program.

Statistical analysis of the data yielded the following information: A significant difference between crack length L, for Run 1 versus Run 2 was found for neoprene. In most laboratories, Run 2 was greater than Run 1. A hint of similar behavior was exhibited for styrene rubber and butyl although further test data would be necessary for a firm decision. A tentative reason for this has been proposed, Mr. Veith declared.

Within-Laboratory Variance

Using the differences between runs as an estimate of within-laboratory variance, a comparison was made of this variance to the between-laboratory variance. The two estimated variances were not significantly different. This indicates that a great amount of variation exists in each laboratory and that further work will be needed in each laboratory to improve chamber performance.

Statistical analysis also showed that the variances associated with the operation of both chambers were equivalent. The grand mean average crack length for Bush versus Mast chambers for neoprene and butyl rubbers, however, were not equivalent. A significantly higher value was reported with the Mast chamber, Mr. Veith reported. This may be due, he said, to less efficient air circulation in the Bush unit.

The over-all picture is one of encouragement, he stated. The agreement between laboratories is considered to be good for a test such as this which is admittedly one given to rather large variations. The degree of agreement between the participating laboratories is about equal to what could be expected in other phases of interlaboratory testing of rubber and rubber products.

U. S. Rubber Appointment

► U. S. Rubber Co., New York, N. Y., has announced the appointment of William F. Wrightnour as director of management development. Known as a speaker and writer on management and merchandising problems, Mr. Wrightnour was formerly operations manager for the Tire Division and coordinator of its management and development activities. He has also served as director of training and assistant to the vice-president and general manager of the Tire Division. Mr. Wrightnour is a member of the training advisory council of the National Industrial Conference Board, a past president of the National Society of Sales Training Executives and a member of the American Management Association.

Named Goodrich Research Manager

► B. F. Goodrich Co., Akron, Ohio, has announced that Dr. Charles H. Stockman has been appointed research operating manager at the company's Research Center in Brecksville, Ohio. A Purdue University graduate with degrees at the baccalaureate and doctorate level, Dr. Stockman joined the Research Center staff in 1940 as a chemical engineer. He was loaned to the Atomic Energy Commission for one year and served at the Argonne National Laboratories. Dr. Stockman is a veteran of World War II and holds membership in the American Institute of Chemical Engineers and the American Chemical Society.

Koppers Forms Two Units

► Koppers Co., Inc., Pittsburgh, Penna., has formed a Plastic Division and a Chemical and Dyestuffs Division to replace the company's former Chemical Division. David L. Eynon, Jr., who has resigned as president of the Mobay Chemical Co. effective April 1, will become vice-president and general manager of the Plastic Division. T. C. Keeling, Jr. has been named vice-president and general manager of the Chemical and Dyestuffs Division.

Detroit Elects Officers; Discusses Air Suspension

► Recent activities of the Detroit Rubber & Plastics Group include an election of officers for the 1958 season and a meeting devoted to air suspension systems. The new officers of the group are: *Chairman*, E. J. Kvet (Detroit Arsenal); *Vice-Chairman*, W. F. Miller (Yale Rubber Mfg.); *Secretary*, W. D. Wilson (R. T. Vanderbilt); *Treasurer*, W. A. Wiard (Dow Corning). The following members have been elected chairmen of the committees noted: *Membership*, Jack Madsen (U.S. Rubber); *Education*, R. W. Malcolmson (DuPont); *Publicity*, P. V. Millard (Automotive Rubber); *Entertainment*, R. C. Chilton (Permalastic Products); *Program*, S. M. Sidwell (Chrysler). T. W. Halloran (Chemical Products), has been named historian.

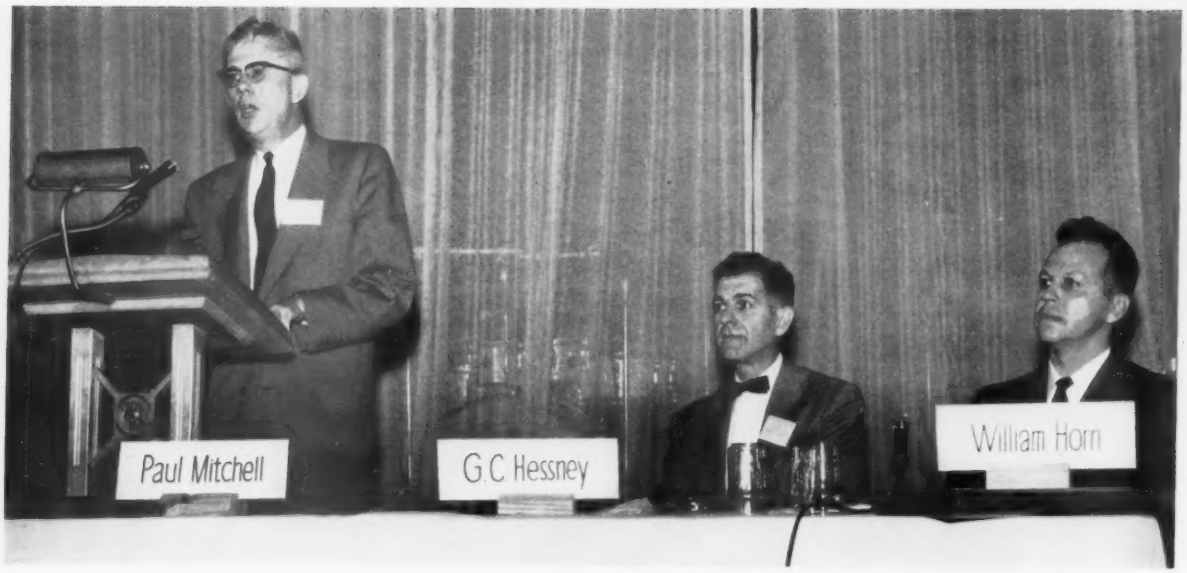
At its February 7 meeting, attended by approximately 100 members and guests, the program was devoted to "A Look at Air Suspension." Held at the Detroit-Leland Hotel in Detroit, the meeting featured the presentation of a paper on "The Evolution and Manufacture of the Airide Spring" by E. A. Harper of the Firestone Industrial Products Co. Mr. Harper's paper was delivered during the technical portion of the meeting.

The after-dinner program speakers included Robert D. Harrison of the Ford Motor Co. who spoke on the Edsel air suspension system, and Donald J. LaBelle of the General Motors Truck and Coach Division, who addressed the audience on General Motors' approach to commercial air suspensions.

New Laboratory Course

In still other news of group activities, R. W. Malcolmson (DuPont), chairman of the Education Committee, has announced that in the Spring semester of 1958, Wayne State University will initiate a new laboratory course in rubber technology which has been prepared in cooperation with the Detroit Group. Supported by contributions from industry, the new laboratory is well equipped to provide students with a thorough grounding in the fundamentals of rubber processing and testing techniques. Equipment includes two laboratory mills, two electrically heated platen presses, a Mooney Viscometer, and a variety of physical testing equipment.

The course will consist of 16 weekly meetings of three hours each which will include one-half hour of discussion and two and one-half hours of laboratory work. Ralph Huizinga (U.S. Rubber) is the instructor for the course. The initial response to this course offering has been large, exceeding the limit for the number of students which has been set at twelve. In addition to the new laboratory course, the Spring semester at Wayne will again see the advanced course offered. This course has had a continuing high level of interest and usually is taken by twenty or thirty students a semester. Continuing as instructor for this course is Clay Albers (Baldwin Rubber).



Shown here is the panel on molded mechanical rubber goods.

Southern Rubber Group Holds Winter Meeting

Two Panel Discussions Feature February 21-22 Sessions at Shamrock Hilton Hotel in Houston

► The Winter Meeting of the Southern Rubber Group, held on February 21 and 22 at the Shamrock Hilton Hotel in Houston, Texas, attracted a registration of 220 members and guests who gathered to participate in two panel discussions. The first of these was concerned with "Carbon Black," while the second covered "Molded Mechanical Rubber Goods." The nontechnical portion of the meeting featured a reception, banquet and special activities for the ladies. A plant tour of the carbon black facility at Baytown, Texas, was provided by the J. M. Huber Corp. About thirty members availed themselves of the opportunity to see the plant.

At a business meeting held in the afternoon on February 21, several matters pertinent to group activities were discussed. The meeting was opened by the chairman, Thomas R. Brown (Goodrich), and the invocation was delivered by Travis Butler (American Rubber), group chaplain. It was announced that the next meeting of the group will be held on June 13 and 14 at the Dinkler Plaza Hotel in Atlanta, Ga.

Announces Nominations

John M. Bolt (Naugatuck Chemical), chairman of the Nominating Committee, reported nominations for the 1958-59 season. These nominations will be voted upon by letter ballot. Those nominated for office include: *Chairman*, Warren Hall (Phillips Chemical); *Vice-Chairman*, Elden Ruch (Firestone), Monroe Mirsky (Guiberson), and R. L. Turpen (Bowling Green Rubber); *Secretary*, Ed Strube (DuPont), R. B. Ehlers (Dow Corning), and C. White (Godfrey L. Cabot); *Treasurer*, H. M. Bowen (United Rubber), James Sparks (Robbins Floor Products), and Ross Whitmore (Better Monkey Grip).

Two directors have been nominated representing suppliers. These are Lenoir Black (C. P. Hall) and Fayette Atkinson (Copolymer). Two other directors representing manufacturers were also nominated: C. Boeder (Goodrich) and J. J. Koch (Texas-U. S.).

Approximately 260 members and guests, including their ladies, attended the dinner which is a highlight of the group's two-day meeting. The dinner, which was held on the evening of February 21, was preceded by a reception and cocktail party held through the cooperation of the suppliers. Warren Hall, group vice-chairman, served as toastmaster at the dinner with C. P. McKenna (Vector Manufacturing) serving as master of ceremonies.

After those sitting on the dais as well as some from the floor were introduced by Mr. McKenna, he called on Tom Brown, group chairman, to make a special presentation. This presentation, which came as a complete surprise, consisted of awarding a specially-engraved silver cup to John Bolt (Naugatuck Chemical) as the Southern Rubber Group's "Man of the Year." It is the first of these awards to be given on an annual basis in recognition of outstanding efforts on behalf of the group.

At this point the master of ceremonies called on E. H. Krismann (DuPont), vice-chairman of the ACS Rubber Division, who indicated that the progress of the group had been noted by the Division and expressed the hope that before another year passed the Southern Rubber Group would become one of the sponsored local groups of the Division. It developed that February 21 was Mr. Krismann's birthday and so the assembled members and guests joined into sing "Happy Birthday."

Speaks on Texas Rangers

The afterdinner speaker was Lewis Rigler of the Texas Rangers. Mr. Rigler outlined the history and function of his organization and made a strong plea for greater parental control of children as a deterrent to juvenile delinquency.

The program for the technical portion of the meeting was arranged by a special committe headed by Warren Hall. The moderator for the first day's panel, that on carbon black, was scheduled to be M. D. Lange, (Columbian Carbon), but due to his

illness he was replaced by R. A. Emmett of the same company.

The first paper to be delivered at the carbon black symposium was that on "Chemistry of Carbon Black in Rubber" by M. L. Studebaker (Phillips Chemical). Mr. Studebaker observed that the study of reinforcement of rubber by carbon black has both a physical and a chemical side. Neither description, by itself, can be complete. It is unfortunately true that our knowledge of these two aspects of reinforcement is fragmentary, Mr. Studebaker declared. The commercial carbon blacks made in the United States are products of pyrolysis, either in the presence or absence of flame. The raw materials are essentially hydrocarbons.

After this basic description of what carbon black is, the speaker went on to discuss reactivity, vulcanization and the catalytic effects of carbon black on vulcanization. Carbon black, for example, is active in promoting a number of reactions involving sulfur-containing materials, some of which are evidently of importance in vulcanization.

Discusses Physical Aspects

Henry Janssen (General Tire), for his part in the panel discussion, concerned himself with the "Physical Aspects of Reinforcement." The speaker noted that the reinforcing action of carbon black in elastomers are threefold: (1) It causes an increase in the energy required to give a certain stress on the chains. This will be beneficial in any application where the destructive action is characterized by constant energy per second; (2) It causes a more even distribution of the stress over the chains. This will increase the resistance of a destructive action operating on a constant maximum force or a constant energy per second basis; (3) It forms a network structure with the crystallites that is highly resistant to tearing. This effect may be very important for good high temperature properties.

All three effects are unconditionally linked with an increase in modulus. It should be realized that the modulus increase at low deformation may be the main reason for the success of carbon black in tread compounds, he said. The three effects

John Bolt (left) receiving his "Man of the Year" award from Tom Brown.

do not appear to offer any reinforcement against a destructive action characterized by constant maximum deformation. This may apply to the case of flex cracking; at least the de Mattia and Ross tests operate on this principle, Mr. Janssen observed.

The third paper at the panel discussion on carbon black was presented by Carl W. Snow (United Carbon) and was entitled "Concerning the Reinforcement of Rubber by Carbon Black". The author presented a theory on the reinforcement phenomenon, stressing these points:

(1) Carbon black does not reinforce a fully saturated polymer. Polymers which are reinforced by carbon black are characterized by double bond unsaturation.

(2) A highly reinforcing carbon black after heating to graphitizing temperatures loses much of its reinforcing character. It also, incidentally, has a reduced capacity for catalyzing the MBT oxidation reaction.

(3) Carbon-gel development level is dependent upon the type carbon black and the polymer unsaturation and cannot be explained by simple immobilization by virtue of the physical adsorption.

(4) Common inorganic rubber fillers are non-reinforcing—even some having particle sizes in the reinforcing carbon black range. Neither do they have pronounced ability to catalyze the MBT oxidation reaction.

(5) Extension of the surface area of a carbon black should enhance its ability to reinforce rubber and in reality, it does.

Two papers were presented at the panel discussion on "Molded Mechanical Rubber Goods." The first of these, "Rubber Molding Techniques and Equipment," by G. C. Hessney (Goodrich), offered a comparison of compression and transfer molding and discussed injection molding, presses for molded rubber parts and auxiliary equipment for the presses.

Mr. Hessney also discussed the question of mold design with particular emphasis on new developments in the field such as the use of transfer molds with no flash or rind on the cured rubber part. Under new developments in molded rubber goods, the speaker outlined the new automatic "turntable" system for molding small rubber parts.

The second paper at this symposium was on the subject "Compounding Variables and Problems in the Molded Rubber Products Industry," by R. P. Mitchell (Goodyear). Mr. Mitchell stated that the ability of a manufacturer to produce quality molded rubber products depends, to a large extent, on his ability to analyze and correct the many compounding problems and variations that occur.

Notes Variation Factors

Excessive variations may be due to incomplete formula development, improper methods as applied to a particular formula, or failure to adhere to established and specified methods of processing. This paper discussed some of the compounding problems and variations and how and why they occur in the several operations. "Quality," said Mr. Mitchell, "cannot be inspected into a product."

At the conclusion of both panel discussions, panel members answered previously submitted questions as well as questions from the floor. A complete transcript of the panel discussion on "Molded Mechanical Rubber Goods" will appear in an early issue of RUBBER AGE.

► Union Carbide Chemicals Co. has announced the opening of a new bulk terminal in St. Louis, Mo.

The panelists pictured here discussed carbon black at the Southern Rubber Group Meeting.

MAN in the NEWS

Fred E. Traflet

► The news that Fred E. Traflet had decided to enter the consulting field has been welcomed by his many friends in the rubber industry who have been acquainted with his activities over the years. Formerly vice-president in charge of sales and research for the Pequanoc Rubber Co. of Butler, N. J., Mr. Traflet has now announced the establishment of a new consulting service on rubber. In his new capacity, he will stress sales development and offer marketing development assistance to suppliers of rubber chemicals and compounding ingredients. Mr. Traflet maintains his headquarters at 39 Elm St. in Butler, N. J.

Mr. Traflet was graduated from New York University with a B.S. degree in chemical engineering. Upon his graduation, he joined the Habirshaw Wire & Cable Co. at Yonkers, N. Y., working in various capacities in the plant and in the laboratory. In 1923, he joined Pequanoc Rubber as chief chemist. In his thirty-four years with the company he spent the greater part of his time on sales and sales service problems and in research activities.

Mr. Traflet is a past-chairman of the New York Rubber Group, a past-president of the Rubber Reclaimers Association, Inc., and a member of the Division of Rubber Chemistry of the American Chemical Society. He holds membership in various local rubber groups about the country and is a member of the Chemists' Club and the Society of Plastics Engineers. During World War II, Mr. Traflet served as consultant to the War Production Board and the Office of Price Administration in Washington, D. C.

Mr. Traflet is married and has three children. The elder of his two sons is a graduate of Villanova University with a degree in chemical engineering and is currently associated with the Allied Chemical & Dye Co. in sales and sales service. His younger son is now an undergraduate student at Villanova. Mr. Traflet's daughter, a registered nurse, is married and busies herself in homemaking.

Mr. Traflet has been active in the Board of Education in Butler for many years, and has contributed greatly to the educational standards of that community. In his spare time, he engages in sail boating and in the operation of a ham radio. Through his more than three decades of association with the rubber industry, Fred Traflet has conducted himself in such a manner that his associates speak of him only in the kindest tones. On his record as a member of the business community, as a public spirited citizen, and as a family man, it can be expected that his new activities in the consulting field will lead to still other accomplishments.

Rubber Division Plans Meeting

► Initial plans for the Spring Meeting of the Division of Rubber Chemistry of the American Chemical Society have been announced by R. H. Gerke (U.S. Rubber), secretary of the Division. The meeting will be held in Cincinnati, Ohio, on Wednesday, Thursday and Friday, May 14, 15 and 16, 1958. The first technical session will start at 2:00 P.M. on Wednesday May 14, with R. F. Dunbrook (Firestone), Division chairman, presiding. This session will be preceded by a regular meeting of the 25-Year Club. The Cincinnati meeting, the 73rd, will feature three sessions of general technical papers and one session will be devoted to a symposium on "High Temperature Resistant Rubbers." This symposium is being arranged by E R. Bartholomew (Wright Air Development Center).

The deadline for papers to be presented at the Cincinnati meeting is March 17. Those desiring to present papers at the meeting should submit a 200 word abstract, in quadruplicate, to the secretary, R. H. Gerke, Research Center, U. S. Rubber Co., Wayne, N. J. An accompanying letter of transmittal should state the laboratory in which the work was accomplished; who will deliver the paper; how much time is required. At least one of the authors of every paper submitted for presentation should be a member of ACS.

The Executive Committee of the Rubber Division will meet at the Cincinnati session to select the Charles Goodyear Medalist. Any Division member may send his nomination to the secretary on or before April 25, 1958. Nomination forms may be obtained from the secretary.

American Zinc Promotes Custer

► The American Zinc Sales Co., Columbus, Ohio, distributor for the American Zinc, Lead & Smelting Co., has announced the appointment of E. A. Custer as assistant manager of sales. Mr. Custer, formerly in charge of sulfuric acid and special products sales, joined American Zinc Sales Co. in New York City in 1948. A graduate of Princeton, with post-graduate work at New York University, Mr. Custer joined the General Chemical Division of Allied Chemical & Dye Corp. after college and was later associated with F. W. Berk & Co., New York. He served as a Naval Officer in the Pacific area during World War II.

German Rubber Conference

► The German Rubber Society (Deutsche Kautschuk-Gessellschaft) has announced that its next general meeting will be held on May 7 to 10 in the Gurzenich, Cologne, Germany. The provisional program for the affair provides for a meeting of members on Wednesday afternoon, May 7. On Thursday morning, May 8, the general meeting will begin, continuing through Saturday at 1:00 P.M. In addition to the presentation of a number of technical papers, the meeting will also feature plant tours and an exhibition of processing and testing machines.

Latex Enters Houston Port

► An 80,000 gallon shipment of natural rubber latex valued at about $250,000 was discharged at the Port of Houston, Texas, early in February, marking the first time that a shipment of latex had moved through the port. The latex was obtained in Indonesia by the Naugatuck Chemical Division of the U.S. Rubber Co. Most of the latex was consigned to Perlfoam, Inc. of Houston, manufacturer of foam rubber products. The firm formerly was supplied by tank cars arriving from storage terminals located at East Coast Ports.

Building Giant Tire Tester

► Adamson United Co. is now building what is said to be the largest tire testing device in the world for installation at the development laboratory of the U.S. Rubber Co. in Detroit, Mich. The giant dynamometer, built at a cost of more than $750,000, will be used to test giant aircraft tires. The new unit will be able to test and qualify aircraft tires in all known sizes and plies at speeds up to 300 mph and at load ratings up to 80,000 pounds. Powered by a 1,250 hp motor and eight feet in diameter, the dynamometer will be the largest piece of equipment in the Detroit laboratory.

International Meeting of ISO/TC45 Held in Zurich

► A report on activities at the seventh meeting of Technical Committee 45 on Rubber of the International Organization for Standardization held on September 30 through October 5 in Zurich, Switzerland, has been made available by Dr. B. S. Garvey, Jr. (Peansalt Chemicals), a member of the American delegation. The official representative for the United States is the American Standards Association, Inc., New York, N. Y. The actual working group for ISO/TC45 in the United States is Committee D-11 on Rubber and Rubberlike Materials of the American Society for Testing Materials.

The chairman of ISO/TC45 is J. M. Buist (Imperial Chemical Industries). Mr. Buist succeeded S. A. Brazier, who passed away since the last meeting of ISO/TC45. Business at the Zurich meeting was carried out by thirteen working groups; by two meetings of the leaders of the various delegations, and in five plenary sessions. Social contacts were fostered by coffee breaks, informal lunches, a banquet, and a half-day excursion to Rigi in the Alps.

Proposals and Methods Discussed

Various proposals and methods were discussed at length by the different working groups. Dr. Garvey reports that this discussion was free and spirited. In most cases, modifications of varying degrees of importance were recommended before the proposals were considered at the plenary sessions. A number of recommendations were accepted for circulation to the member nations as draft ISO proposals, subject to revision by the Secretariat. In other cases it was decided by the working groups or in the plenary sessions that further work must be accomplished before draft proposals could be prepared.

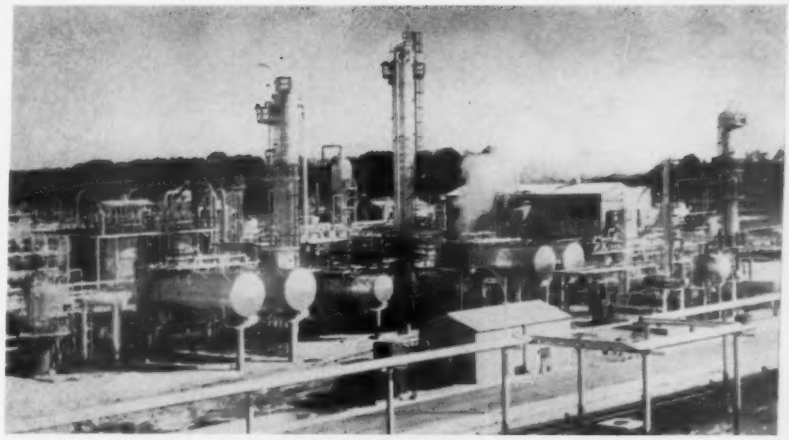
Methods for which draft ISO proposals are being circulated involve such subjects as rubber-to-metal bonding; compression set; low temperature—brittleness; low temperature — stiffness; classification of vulcanized rubber; ozone resistance; sampling of raw rubber; dirt in raw rubber; volatile matter in raw rubber; ash in raw rubber; rubber hydrocarbon in raw rubber; Mooney viscosity for raw rubber.

Also, Viscometer cure characteristics for natural and synthetic rubbers; electrically conductive rubber; density of latex; volatile fatty acids in latex; tear strength—Delft specimen, and microhardness. At the next meeting there will be discussions of specifications for rubber products. Member countries were invited to submit a list of products they wish to have considered. The next meeting will be held in New York City during the week of October 26 to 31, 1959. Italy has extended an invitation to hold the ninth meeting in Milan.

The last (sixth) meeting of ISO/TC45 was held in Dusseldorf, Germany, in September, 1955. In the meantime, and prior to the seventh meeting, the work of the committee has been carried on by correspondence and by meetings of the working groups. Geography and travel requirements make it much simpler for delegates in Western Europe to get together at working group meetings than it is for delegates from Asia and the Americas.

The fourteen countries represented on the committee include most of the major manufacturing countries of the world, countries in which probably 90 per cent of all rubber manufacturing is done and in which a high proportion of all rubber products bought on technical specifications is used. The seventy-five delegates representing these countries are well-qualified to deal with problems of evaluation and standardization.

The delegates, particularly those from Western Europe, obviously feel that there is a real need for international standards, Dr. Garvey reports. Because of the large volume of production covered by ASTM standards, Dr. Garvey states, there is a less immediate interest in international standards in the United States. However, the U. S. delegates do recognize the more pressing need in Europe for such standards and they also recognize that any official international standard should be satisfactory for use in the U. S. Hence, Dr. Garvey declares, the U. S. should continue to send competent delegates and should cooperate fully in the development of international standards.



Grace Dedicates Polyethylene Plant

► Polymer Chemicals Division of W. R. Grace & Co., New York, N. Y., has dedicated a new 50 million pound high density polyethylene plant located at Baton Rouge, La. Representing an investment of more than $20 million, the plant is located on 150 acre site and houses a staff of 250. The new facility was constructed specifically for the manufacture of "Grex", the company's new high density polyethylene, production of which is based on a process developed by the Phillips Petroleum Co. A high quality basic plastic that can be easily fabricated, the new material is said to remain stable over a wide range of temperatures and to be resistant to acids, alcohols, greases and solvents.

The new unit utilizes ethylene gas, greases and solvents in the manufacture of Grex and has continuous process operations with high instrumentation. Major sections of the plant include: catalyst preparation, polymerization, ethylene removal, catalyst and polymer recovery, solvent removal, finishing boiler plant and off-site facilities.

► Chicago Rawhide Manufacturing Co., Chicago, Ill., has announced the availability of a full range of C/R industrial O-rings in standard sizes and compounds.

Gates Rubber Scholarships

► Gates Rubber Co., Denver, Colo., has announced that it will offer four-year scholarships to Colorado high school graduates. Charles C. Gates, company president, said the scholarships will provide tuition plus $50 a month during the school year, at any accredited college or university in the United States. A minimum of 10 scholarships will be presented under the Gates Foundation Opportunity Scholarship Program. Mr. Gates said that by the fall of 1961, when the program is expected to be in full swing, 40 to 50 students will be participating in the program each year. The Gates Foundation has participated in various educational programs in past years. These awards mark the first time the company has offered scholarships.

Building Karachi Footwear Unit

► A new company called the Pak General Boot Factory has been established in Karachi, Pakistan, by the General Boot House of Karachi for the production of 720,000 pairs of rubber and canvas shoes annually. Presently under construction, a complete modern plant has been imported for the new unit, which will be located at Sind Industrial Trading Estates, Monghopir Road, Karachi, 16. General Boot House, Elphinstone St., Karachi 3, Pakistan, would like to hear from suppliers of chemicals and raw materials suitable for the new factory.

The Messrs. Humphreys and Sears at the Washington Rubber Group tenth anniversary meeting.

Washington Rubber Group Holds Special Decennial Celebration

► The Washington Rubber Group observed its tenth anniversary with a special Decennial Celebration held on February 18 at the National Press Club in Washington, D.C. The meeting featured a technical session which was followed by a reception and a banquet. Approximately 50 members and guests attended the technical portion of the meeting which featured papers by Dr. Allen V. Astin (Bureau of Standards) and Dr. R. P. Dinsmore (Goodyear). H. E. Humphreys, Jr., chairman of the board of the U.S. Rubber Co., was featured speaker at the banquet.

A special Decennial Committee planned the program for the celebration under the chairmanship of T. A. Werkenthin (Bureau of Ships). Other committee members included W. J. Sears (RMA), N. Bekkedahl (Bureau of Standards), T. Scanlan (Gates Rubber), Harold Wirth (Firestone), G. Kochis (Minnesota Mining), A. Sloan (Atlantic Research), Harold Sill (General Tire), C. Miller (RMA), and George Flanagan (Goodrich).

Importance of Measurement

In his address, entitled "Measurement, Rubber Research and Technological Competition," Dr. Astin first outlined the important relationship of physical measurement to technological progress. Next, the speaker discussed the responsibilities of the National Bureau of Standards in advancing the science of accurate measurement.

The dependence of technological progress upon advances in measurement techniques is neither widely understood nor appreciated, the speaker observed, pointing out that rubber technology has advanced as it has become possible to measure the physical and chemical properties of the rubber more precisely. Dr. Astin concluded his address with a discussion of measurement activities in the U.S.S.R. He spoke of the Soviet Union's extensive program in the techniques of physical measurement and how this program contributes to that country's competitive position.

Dr. Dinsmore's paper, "Tires for Today's Cars," was delivered by James D. D'Ianni (Goodyear), Dr. Dinsmore being indisposed at the time of the meeting. In his paper, Dr. Dinsmore pointed out that a tire which cannot run for an hour under summer conditions at sustained high speeds is not an acceptable piece of equipment for a modern automobile. Requirements for winter tires, he stated, are no less severe.

Dr. Dinsmore's paper pointed out that the drastic changes in the character of our public highways and the performance of the automobile, particularly during the past five years, has required a rapid and continuous evolution of the tire to keep pace. Fortunately, he declared, the rubber industry has been able to keep pace with these demanding changes.

Approximately 140 members and guests of the group attended the reception and banquet which followed the technical program. W. J. Sears served as toastmaster at the banquet and outlined the history of the group. Mr. Sears then introduced the first ten presidents of the Washington Rubber Group: T. A. Werkenthin (1948-49), R. J. Devereaux (1949-50), Warren Stubblebine (1950-51), T. R. Scanlan (1951-52), Norman Bekkedahl (1952-53), George M. Riveire (1953-54), P. S. Greer (1954-55), E. A. Bukzin (1956-57), and D. K. Bonn (1957-58). Mr. Sears himself served as president of the group in the 1955-56 period.

The toastmaster also introduced the Program Committee and announced the election of two new life members in the Washington Rubber Group: E. G. Holt and T. A. Werkenthin. There is only one other life member of the group, Harry L. Fisher. It was announced at the meeting that appropriate pins were being mailed to charter members of the group. All present received copies of a special Decennial booklet, a 56-page publication which contains a history of the group, a membership list, and much other pertinent information. Copies of the booklet may be obtained for $1.00 by members and for $2.00 by non-members. Write to the secretary, Dr. A. W. Sloan, Atlantic Research Corp., 901 North Columbus St., Alexandria, Va.

Humphreys Addresses Banquet

The featured speaker at the banquet, Mr. Humphreys, spoke on "Rubber's Role in our Nation's Strength." Mr. Humphreys stated that the job of getting America out of its current recession lies primarily in the hands of business, and too much

T. A. Werkenthin (left) and R. D. Stiehler pictured at the anniversary dinner.

government "tinkering" might well make it worse than it is.

The main theme for Mr. Humphreys' talk was a plea that industry take stock of the ways it aids and can aid the military and civilian strength in the present period of international emergency, which he said is no less urgent than in a shooting war. The rubber industry, he stated, is contributing to that strength by maintaining an adequate and protected raw material supply, a skilled work force, and financial strength.

The rubber industry, he said, has not done its best job in providing an adequate return on invested capital, and the primary reason is that wage costs in the industry have increased 60 per cent during the past ten years while output rose only 24 per cent.

Mr. Humphreys commended the stockpile advisory committee of the Office of Defense Mobilization for recommending a three-year stockpile base for natural rubber, rather than the present five-year base. He cautioned, however, that a sudden dumping of stockpile rubber onto the market would cause an immediate break in rubber prices and would not be fair to either taxpayers or rubber producers.

The long-term future of natural rubber, he stated, depends upon a policy of producing a lot of rubber at a low price. Rubber can be raised at prices as low as 9 or 10 cents a pound, he said, but there are trade factors which tend to keep prices higher. High tax rates on exports, particularly from Indonesia, add to such prices. Also, since rubber is traded on the commodity exchanges, its price is subject to every news item on Southeast Asian economics and politics.

"If lower and more stable prices for natural rubber are delayed too long, the rubber producing countries will find that they have been holding an umbrella over the development of a synthetic which can replace it entirely," he said.

Building Edinburgh Hose Factory

► Construction of a new industrial hose factory in Edinburgh, Scotland, has been announced by North British Rubber Co., a subsidiary of the U. S. Rubber Co. Modern production equipment, to be installed in the new plant, will be used to make a range of hose for the world's oil fields, and high pressure hose for the British market. Ground was broken in December for the modern plant which is part of a $8,500,000 modernization program extending over the next four years. The 145,000 square foot, one-story steel and brick structure is expected to be completed in late 1958.

During the past year the Edinburgh plant, called Castle Mills, has doubled its tire production capacity. Plans are now being made to add still more capacity to the tire-making lines. With technical assistance from U. S. Rubber, the company plans to add new products to its lines. Among these are several recently developed types of industrial hose, transmission belting, vinyl plastic flooring, non slip driving belts, molded plastics and sponge products.

John McGavack

Retires From U.S. Rubber

► John McGavack, technical director of the Plantation Division of the U.S. Rubber Co., has announced his retirement effective February 28, 1958. Well-known to the rubber industry for his many years of service as chairman of the Bibliography Committee of the Division of Rubber Chemistry, American Chemical Society, Dr. McGavack was born in Waterford, Virginia. In 1913 he received his A.B. degree form Hampden-Sydney College, and in 1920 he received his Ph.D. from Johns Hopkins University, where he was a member of Phi Beta Kappa. Shortly thereafter, Dr. McGavack began his long association with the U.S. Rubber Co. One of the first problems with which he was concerned involved research on polyvinyl chloride, then known as "cauprene chloride." In the years which followed, Dr. McGavack became quite active in the latex field, and a number of U.S. patents were issued in his name. At one time it was calculated that one of Dr. McGavack's patents was worth at least a half cent per pound of dry rubber.

Among the subjects covered in some of the 43 patents issued to Dr. McGavack is the use of chemical creaming agents in the concentration of rubber latex; the use of formaldehyde together with ammonia in the preservation of latex, etc. More recently, he received patents dealing with the preparation of the specially purified rubber known as "F-Rubber." His activities were not entirely confined to latex, however. He also worked on the development of rubber derivatives, including rubber chloride and hydrochloride, and held one of the basic patents in this field. Dr. McGavack was instrumental in the establishment of the modern "split level" greenhouse at the company's research center at Wayne, N. J.

In his capacity as chairman of the Bibliography Committee, Dr. McGavack has been responsible for carrying forward the preparation and the editing of the Bibliography of Rubber Literature. It is Dr. McGavack's intention to continue with his Bibliography work, at least for the time being. His current plans include a Florida vacation.

International Meeting Plans

► The Program Committee for the International Meeting which is scheduled to be held in 1959 in Washington, D.C., met on January 31 in Philadelphia, Penna., under the chairmanship of B. S. Garvey, Jr. (Pennsalt Chemicals). The technical program for the International Meeting will cover a full five days. The first day will be devoted to technical subjects falling within the province of the Rubber and Plastics Division of the American Society of Mechanical Engineers. The following day will be the province of Committee D-11 on Rubber and Rubberlike Materials, American Society for Testing Materials. The Division of Rubber Chemistry of the American Chemical Society will be concerned with the proceedings of the next three days. At the meeting of the Program Committee, it was decided to hold ten half-day sessions. Under each general subject heading, three or four subheadings suggest more specific topics. The following subjects and subheadings have been suggested by the Program Committee.

1—Equipment and Processes in Rubber Manufacturing (automation, new equipment and new processes); 2—Elastomers as Engineering Materials (vibration dampers, sealants and materials handling); 3—Advances in Test Methods (small scale, deterioration, dynamic and control); 4—Production Testing (tires, belts and foam); Statistical Methods in the Rubber Industry (research and development, testing and production); 6—Nomenclature and Classification (general terms, elastomers and compounds); 7—New Developments in Elastomer Reinforcement (carbon blacks, mineral products and resins); 8—Compounding Developments (vulcanization, rubber chemicals and special applications); 9—Polymers and Polymer Structure (stereospecific elastomers, polyurethane elastomers and elastomers for high temperature use); 10—Latex (plantation practice, compounding and applications).

The Program Committee hopes to have four to six papers in each of the ten categories mentioned. The selection of the ten categories is intended to suggest papers rather than to restrict or exclude them. Good papers on any subject will be welcomed. Within the next few weeks a general notice will be circulated calling for the submission of papers.

Approves Thermoplastic Insulation

► Underwriters' Laboratories, Inc., has approved the use of thermoplastic insulation on building wires as announced in *Bulletin Subject 83*, dated February 6, 1958. The compounds employing polyvinyl chloride or copolymers of vinyl chloride and vinyl acetate have been investigated by the Laboratories and have been found to be acceptable for use on Type T, Type TW, and 60° C. oil-resistant building wires employing copper conductors. The bulletin lists nine resin suppliers and eleven compound suppliers as being acceptable to the Underwriters' Laboratory standards.

Names in the News

J. R. Brandon has been appointed manager of the Field Service Department of the Industrial Products Divisions, Hewitt-Robins, Inc., and **J. H. Hayden, Jr.,** has been named product manager of conveyor sales in the Robins Conveyors Division.

Dr. Karl Arnstein, retired vice-president in charge of engineering for Goodyear Aircraft Corp., has been awarded the Navy Distinguished Public Service Award for outstanding contributions to the Naval Establishment in the fields of scientific research and development.

John W. Shepherd, previously Advertising Department manager for the Drackett Co., has been named advertising manager for Rubbermaid, Inc.

Alice Josephine Gitter, formerly director of market research for Whittaker, Clark & Daniels, Inc., has been named director of market research for the United Mineral & Chemical Corp.

William B. Philipbar, Jr., previously with the Esso Standard Oil Co., has been appointed product sales manager for the Stearates Division of Nuodex Products Co.

Clyde O. DeLong, president of B. F. Goodrich Industrial Products Co., has been presented with an engraved wrist watch in recognition of his 30th anniversary with the company.

Clement H. Watson, general manager for the Atlantic Gelatin Division of the General Foods Corp., has been elected a director of the Alco Oil and Chemical Corp.

James C. Hance, formerly with the American Cyanamid Co., has been appointed manager of market research for the Commercial Development Division of the Jefferson Chemical Co.

Harold B. Lawson, previously treasurer of the Dobeckmun Co. of Cleveland, Ohio, has been named controller of the United Carbon Co.

W. E. Greene, chairman of the board of W. E. Green Corp., has been re-appointed chairman of the Rubber Division for the New York City Cancer Committee's 1958 April Cancer Crusade.

William T. Hepburn, formerly manager of passenger tire sales for the Firestone Tire & Rubber Co., has been named manager of the Manufacturers Sales Division, succeeding Arthur N. Stuart.

Herman Muehlstein, president of H. Muehlstein & Co., Inc., has been named chairman of the Rubber and Plastics Division for the 1958 Heart Fund annual campaign.

Oswald S. Carliss, director of engineering of Yale Materials Handling Division, Yale & Towne Manufacturing Co., has been elevated to the Grade of Fellow by the American Society of Mechanical Engineers in recognition of "acknowledged engineering attainments".

Coleman S. Bost, formerly associated with the Celanese Corp. of America, has been appointed to the Synthetic Industrial Fabrics Department, J. P. Stevens & Co., Inc., and will concentrate on technical service to customers in the sale of synthetic fibers.

Joseph Anastasio, previously district sales manager, has been appointed general sales manager of consumers' products in the Footwear and General Products Division, U. S. Rubber Co., New York, N. Y.

Robert F. Leising has been named Service Department manager of the Firestone Tire & Rubber Co., Akron, Ohio, succeeding **E. C. Labbe,** who is retiring.

Alfred B. Lingley, factory consultant for the Bristol Manufacturing Co., has been installed as Illustrious Potentate of the Palestine Temple Shrine, Bristol, R. I.

J. A. Reeves, vice-president of the Dryden Rubber Division and general manager of the Keokuk, Iowa, plant, was elected a director of the Sheller Manufacturing Corp.

Dr. John N. Pattison has been appointed director of research and development for Girdler Catalysts in the Chemical Products Division of National Cylinder Gas Co., while **John W. Benedict** has been named sales manager.

George H. Quinn has been named manager of Detroit automotive sales for the Landers Corp. and **Russell J. Martin, Jr.** will represent Landers' interests at Ford Motor Co. and all of its divisions.

Charles R. Ince, associated with the St. Joseph Lead Co. since 1929, has been elected to the company's board of trustees.

J. Lawrence Pond, formerly vice-president in charge of purchasing for the Seamless Rubber Co., has been promoted to treasurer, while **Edward C. Crotty,** previously assistant secretary and assistant treasurer, has been named secretary and assistant treasurer of the company.

► Rodney Hunt Machine Co., Orange, Mass., has issued an industrial roll report, entitled "Roll Design Considering Critical Speed" which describes how correct design can eliminate serious vibrations in rotating rolls by avoiding their critical speed. Ask for Report No. 13.

Louis J. Healey

Elected U.S. Rubber Vice-President

► Louis J. Healey has been named vice-president of the U. S. Rubber Co., New York, N. Y., and general manager of the company's Mechanical Goods Division. Mr. Healey is a graduate of the University of Oregon with a B. B. A. degree. He became associated with U. S. Rubber in 1939 as a sales clerk in the San Francisco branch and the following year, he became a salesman for the Footwear Division. From 1941 to 1946, he was on leave from the company, and served with the U. S. Navy, becoming a lieutenant commander. When Mr. Healey returned to the firm, he was appointed assistant to the San Francisco district sales manager. In 1947, he became district sales manager of the branch and in 1948, he was made Pacific Coast sales manager for the Footwear Division. Mr. Healey was appointed sales manager of general products in 1952 and nine months later, he was promoted to assistant manager of branch sales for the Footwear and General Products Division. In 1954, he was named manager of the nation-wide branch sales organization of the Footwear and General Products Division and was promoted to general sales manager of consumers' products for the division in 1956.

Acquires Thermoid Stock

► H. K. Porter Co., Inc., Pittsburgh, Penna., has acquired close to 40 per cent of the common stock of the Thermoid Co., Trenton, N. J., making it the largest shareholder in the rubber and plastics products concern. Company officials said that about 253,000 shares (24 per cent) of Thermoid were purchased from the Graham Paige Corp. for cash. Porter also purchased about 82,000 shares in the open market, making an approximate total of 335,000 shares of the 847,000 outstanding common shares of Thermoid. Employing about 3,000 persons, Thermoid makes automotive friction and rubber products, hard and soft rubber molded goods and plastic products. H. K. Porter Co. is a major producer of industrial rubber products through its Quaker Rubber and Quaker-Pioneer Rubber Divisions.

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To provide excellent durability and tear resistance at the most economic level... Columbian produces STATEX—B... fine furnace black. Where other special characteristics are required... Columbian provides a wide range of blacks that assures optimum results. Extensive research on carbon black characteristics... plus precise production control... enable Columbian to supply you with the perfect carbon black for every requirement.

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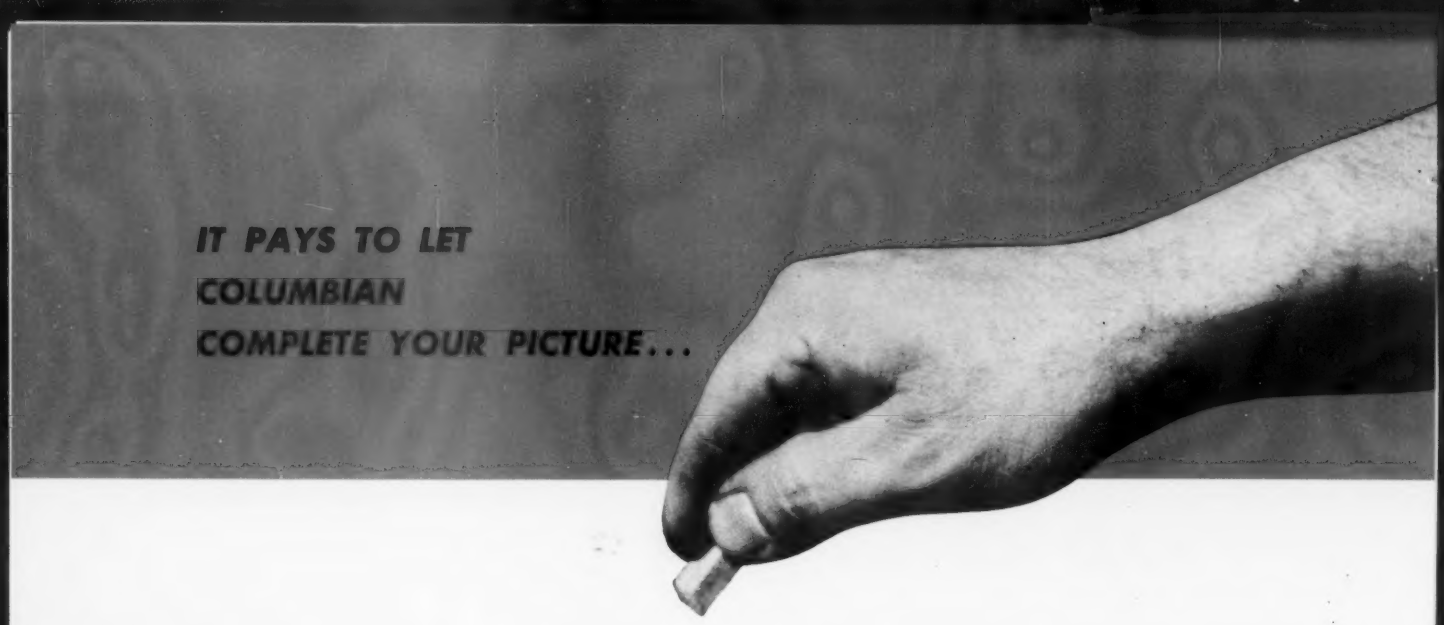

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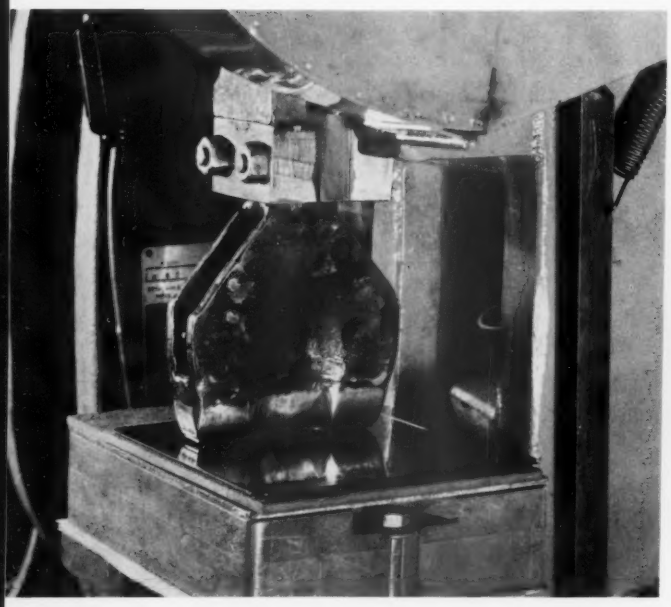
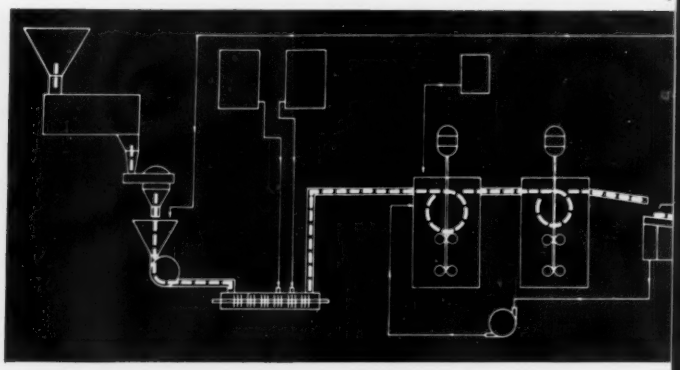


BECAUSE...

In a laboratory that has made many important contributions to the industry... Columbian specialists work endlessly with rubber formulations... test and retest until results meet the most exacting specifications!



BECAUSE...

Columbian is responsible for so many major steps ahead... developments like the latex masterbatching process which has spurred the whole industry to vital new progress!

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Columbian has a carbon black for every need.

STATEX®-160 SAF Super Abrasion Furnace
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MICRONEX W-6 EPC Easy Processing Channel
STATEX-B FF Fine Furnace
STATEX-M FEF Fast Extruding Furnace
STATEX-93 HMF High Modulus Furnace
STATEX-G GPF General Purpose Furnace
FURNEX® SRF Semi-Reinforcing Furnace

BECAUSE...

Columbian pioneered with reinforcing carbon blacks... created MICRONEX more than four decades ago... made it a synonym for reinforcement! Today, Columbian's MICRONEX is the industry's standard for natural rubber, heavy-duty, truck tires... and heavy-duty insulation for wire and cables.

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C. P. Moore

Named Goodyear Representative

► The appointment of C. P. Moore as special representative has been announced by the Chemical Division of the Goodyear Tire & Rubber Co., Akron, Ohio. Mr. Moore will service rubber, plastics, textile, paint and paper processing accounts in both North and South Carolina from headquarters in Charlotte, N. C. He joined Goodyear in 1957 with eight years experience as research chemist and production supervisor in the textile industry. Following a preliminary sales training program, he was assigned to direct field duties. Mr. Moore is a chemistry graduate from Catawba College and is active in the American Association of Textile Chemists and Colorists and the Southern Rubber Group.

Sun Wins Court Decision

► United States District Court, Cleveland, Ohio, has ruled in favor of the Sun Rubber Co., Barberton, Ohio, against two Akron area firms, which the court found had infringed valid patent rights on machinery and manufacturing methods owned by Sun. Defendants in the suit were the National Latex Products Co., Ashland, Ohio, and the Akron Presform Mold Co., Cuyahoga Falls, Ohio. The patents are known as the Molitor Patent 2,629,134 and the Martin and Rekettye Patent 2,629,131. The first covers the method of making hollow articles such as dolls, playballs and toys from vinyl resins by a rotational casting method which Sun originated and the second patent covers the machinery which performs this patented process. According to Sun Rubber spokesmen, the decision is of far reaching importance in many industries where the processes have been or could be used.

Harwick Adds Pulverized Clay

► Harwick Standard Chemical Co. Akron, Ohio, has announced the addition of a pulverized clay to its line of water-fractionated clays for the rubber industry. "Harwick Clay No. 1-P" is a pulverized form of "Harwick Clay No. 1" with a color (brightness) of 83 to 85 per cent.

Enters European Field

► William Leistner, president of Argus Chemical Corp., Brooklyn, N. Y., has been named president of SA Argus Chemical NV, a new European company which has been formed by Argus and Union Chimique Belge, Brussels, Belgium, to develop world markets for Argus vinyl stabilizers and plasticizers. Union Chimique Belge is a major manufacturer of industrial chemicals on the Continent. The new company will manufacture and sell Argus products in most of the free European countries. At the same time, a licensing arrangement has been made whereby Lankro Chemicals, Ltd., Manchester, England, has been granted rights to represent Argus "Mark" stabilizers under a new trade name, "Lankro Mark." Lankro is a major producer of plasticizers and is England's largest manufacturer of chemicals for treating leather. Comprehensive technical service and basic vinyl plastic research will be continued abroad, the company reports. Technical personnel will be trained in the U.S.A. under Dr. Arthur Hecker, Argus' Director of Research and an international authority on vinyls.

Named Tire Plant Manager

► United States Rubber Co., New York, N. Y., has announced the appointment of Frank A. Cobb as manager of the Detroit, Mich., tire plant. Mr. Cobb, formerly manager of the Eau Claire, Wisc., plant, succeeds Harold E. Weigold, who has been made assistant to the Tire Division's production manager. Mr. Weigold will work at headquarters in Detroit on technical and processing problems for the company's five tire plants. Succeeding Mr. Cobb as Eau Claire plant manager will be Robert G. Francis, formerly assistant factory manager. Mr. Cobb, who started with U. S. Rubber in 1934 at Eau Claire in labor standards work, was made factory manager in 1952 after having been production superintendent since 1949. Mr. Francis started with the Indianapolis plant in 1933, was made general foreman of the Chicopee Falls, Mass., plant in 1944, and was appointed assistant factory manager of the Eau Claire plant in 1955.

Philprene 1805 Announced

► A new pigmented, oil-extended cold rubber polymer, named "Philprene 1805" has been developed by Phillips Chemical Co., Akron, Ohio. The new synthetic rubber contains 75 parts of Philblack O, a High Abrasion Furnace (HAF) carbon black, and 37.5 parts of a napthenic type oil. The product was developed under the experimental number "6600." The rubber, carbon black and oil are coprecipitated by a new process, said to produce a compound of excellent physical properties readily adaptable for use in tread rubber and industrial goods. Its early acceptance by the rubber industry indicates widespread use of this polymer because of its high qualities obtainable at substantial savings in costs, the company claims.

Harry Fishman

Appointed DuPont Representative

► Harry Fishman of the Elastomer Chemicals Department, E. I. du Pont de Nemours & Co., Inc., has been assigned as a technical representative in the Boston District. Mr. Fishman formerly worked in DuPont's Elastomers Laboratory where he did technical service work on urethane foam, neoprene, Hypalon synthetic rubber, and Adiprene urethane rubber, and for a year as a sales correspondent. A chemical engineering graduate of Northeastern University, Mr. Fishman was previously an assistant instructor at the University of Michigan while doing graduate work there. He is a member of the American Chemical Society and the Boston Rubber Group.

Doyle Named Manager

► J. T. Doyle has been named manager of the Andrews-Alderfer Division, Kendall Co., Akron, Ohio, succeeding R. M. Hoey, who had been general manager since Kendall bought the operation in December, 1955. Mr. Hoey has been reassigned as works manager of the Chicago Division of the company and will be in charge of operating management of plants in Chicago, Rockford, Ill.; South Bend, Ind.; Franklin, Ky.; Toronto, Ont.; Mexico City, and Akron. Mr. Doyle joined Andrews-Alderfer in 1956 as Mr. Hoey's assistant. Prior to that he was head of the industrial products section of Kendall's research laboratories.

Fatty Acids Division Formed

► Pulp Chemicals Association, New York, N. Y., has formed a Fatty Acids Division in order to handle the problems of manufacturers of tall oil fatty acids. Initially, the division is expected to promote greater use of this product. The Pulp Chemicals Association was set up in 1947 to develop uses for various chemical products of the kraft pulp industry, including tall oil and sulphate turpentine. Comparatively new, tall oil fatty acids have secured acceptance and are now produced at an annual rate of approximately 50,000 tons.

Financial News

General Tire Scores New Sales Record In Fiscal 1957

► William O'Neil, president of the General Tire and Rubber Co., has announced in his annual report to the stockholders that the company reached a new record in sales and its second highest net income during the fiscal year ended November 30, 1957. Consolidated earnings, including those of the company's RKO Teleradio subsidiary were $11,300,355, which is equal to $2.12 a share, an increase of 4.1 per cent over $10,963,000, or $2.30 a share, in fiscal 1956.

Consolidated sales in 1957 totaled $421,165,147, an increase of 7.9 per cent over the previous year's sales, which amounted to $390,471,772. This figure does not include the sales of the RKO Teleradio Pictures, Inc., nor those of the company's operations outside of the United States excepting its Canadian company.

During the year important transactions having to do with the company's financial operations were successfully concluded, the General Tire president stated. With shareholders' approval at the annual meeting, the company's outstanding Preference Stock issues were reduced from seven to three. "This was a move needed to simplify our capital structure," Mr. O'Neil said. "Since only $691,000 of the old Cumulative Preferred Stock remains outstanding, this Preference Stock now is, for all practical purposes, the first preferred stock of the company."

Changed Authorized Common

Last September 5 the General Tire shareholders voted to change the authorized Common Stock from 2,500,000 shares of $2.50 par value to 7,500,000 shares of 83-1/3 cents par value, and to change each issued share of $2.50 par value into three shares of Common Stock, par value 83-1/3 cents. "As an addition to our working capital position, we completed during the year the sale of $12,000,000 of 6% subordinated debentures with Common Stock warrants attached," Mr. O'Neil reported. "The warrants, when exercised, will bring in additional equity capital."

Another important financial transaction, it was pointed out, was the borrowing on a long-term basis $9,000,000 from banks to complete the erection of General Tire's Odessa synthetic rubber facility, which began operations late in 1957.

Discussing the over-all business, the General Tire president added: "The success of our Dual 90 passenger car tire was the highlight of our rubber business. It afforded our distributors with another 'first' with no competitive rival. As a result, our total distributors' purchases were greater than last year despite a declining truck tire demand. The increase in our overall passenger car tire sales improved our industry percentage."

Dayton Rubber

► Year to October 31, 1957: Net income of $1,613,634, which is equal to $1.59 per share, compared with $2,593,003, or $2.99 a share in the previous fiscal year. Sales in fiscal 1957 totaled $83,613,850, compared with $75,813,409 in the preceding year. These figures do not include Dayton Rubber's share of the undistributed earnings of Copolymer Rubber & Chemical Corp., one-seventh owned by Dayton. In 1957, this share amounted to approximately $355,000, equal to $.37 per Dayton share. This compares with $310,000, o $.37 per Dayton share in 1956 on a lesser average number of shares outstanding. Also excluded from the year's earnings figure are profits of Cadillac Plastic and Chemical Co. for the first half of fiscal 1957. Cadillac, the nation's largest warehouse distributor of plastic sheets, rods, tubes and other plastics and chemical products, was acquired by Dayton Rubber in the third quarter of fiscal 1957. Had this company's results been included for the full year 1957, as they will be in the next fiscal year, net sales would have been approximately $3,750,000 greater, and net earnings $180,000 or $.19 per share larger.

American Cyanamid

► For 1957: Consolidated net income of $51,348,000, which is equal to $2.42 per share, compared with $44,247,000, or $2.11 a share in the preceding year. Consolidated net sales in 1957 amounted to $532,479,000, an increase of about 6 per cent above the $500,651,000 volume in the year before. Before taxes, earnings for 1957 amounted to $102,348,000, compared with $85,247,000, exclusive of extraordinary gains in 1956. Provision for Federal and foreign taxes on income totaled $51,000,000 in 1957 and $41,000,000, in 1956. Cyanamid states that in 1957 the company achieved the highest sales and earnings in its history.

St. Joseph Lead

► For 1957: Net income of $8,026,273, which is equal to $2.95 a share, compared with $10,291,357, or $3.79 a share, in 1956. The company states that the drop in income reflected a sharp cut in prices for lead and zinc, reduced domestic demand for both metals, and competition from foreign imports at lower prices.

American Zinc

► For 1957: Net income of $1,259,937, which is equal to $1.07 per share, compared with $3,227,864, or $2.74 a share, in the previous year. Sales in the year ended December 31, 1957, totaled $59,136,647, against $76,847,945 in 1956.

Sales and Earnings in 1957 Set New Goodyear Record

► Goodyear Tire & Rubber Co., Akron, Ohio, which this year observes its 60th anniversary, has reported the highest sales and earnings in the company's history for the year 1957. Net income was $64,825,516, which is equal to $6.12 per share, a gain of 3.7 per cent over 1956 earnings of $62,456,130, or $5.90 a share. Sales last year increased 4.6 per cent to a new high of $1,421,850,335, compared with $1,358,763,538 reported in 1956.

Goodyear's capital expenditures for plant expansion and improvements last year totaled $82,947,363 compared with $88,850,592 the year before. Enlargement of the company's synthetic rubber plants in Houston, Texas, and Akron, Ohio, raised their combined capacity to 245,000 tons yearly, the largest in the industry. Four new tire plants, located in Colombia, Venezuela, the Philippines and Scotland, reached full production during the year. A new tread rubber plant was established in Chehalis, Wash., and practically every Goodyear plant in the United States and abroad received some additions and improvements. Substantial expenditures were also made for improved wholesale and retail selling facilities. Active production of equipment for the armed forces is continuing, Goodyear officials reported.

Foreign Operations Cited

Goodyear's foreign operations last year contributed $17,308,192 to consolidated net income, after excluding $1,685,000 of restricted foreign earnings added to the reserve for foreign investments. This compares with foreign profits of $17,503,887 the year before, when there were no restricted earnings. To adjust foreign current assets to prevailing rates of exchange, a charge for devaluation of $2,392,000 was made to the foreign investment reserve.

Working capital at the year-end amounted to $449,191,019 compared with $451,333,260 at the close of 1956. Income taxes last year totaled $67,727,000, equivalent to $6.39 a share, compared with $66,299,000, or $6.26 per share in 1956, while taxes of all kinds reached a new high of $181,547,000.

Baldwin Rubber

► Six months to December 31: Net income of $196,951, which is equal to 46c a common share, compared with $376,062, or 87c a share, in the same period of 1956. Sales in the last half of 1957 totaled $8,034,264 compared with $7,160,002 during the same period of 1956.

Eagle-Picher

► Year to November 30, 1957: Net income of $4,266,706, which is equal to $4.25 per share, compared with $5,496,794, or $5.47 a share, in the previous fiscal year. Sales in the year to November 30, 1957, totaled $117,752,694, compared with $116,407,000 in 1956.

Seiberling Earnings Down 10% Despite Higher Sales

► Seiberling Rubber Co., Barberton, Ohio, has announced that sales in 1957 were slightly over 1956 and that the company's United States divisions had a good profit year. However, a dip in Canadian earnings caused a decline of 10 per cent in consolidated net income. Net income in 1957 was $943,011, which is equal to $1.75 a share, compared with $1,051,049, or $1.99 a share, the preceding year. Earnings do not include the increase in the company's equity in Copolymer Rubber and Chemical Corp., which equals 90c a share for 1957.

Net sales in 1957 totaled $46,934,437, compared with $46,633,811 reported in 1956, thus reaching a new high. Total current assets were $18,772,347 compared with $17,823,413 the year before and total current liabilities in 1957 were $8,268,769 compared with $7,294,632 in the preceding year.

The company had its highest unit sales in 1957, with the improvement in passenger and truck replacement tires offsetting a "substantial decline" in sales of large tires to truck and trailer manufacturers, Mr. Seiberling said. The Canadian subsidiary, completing major plant expansion, had manufacturing problems resulting in higher costs and "a sharp decline" in profits, particularly in the last four months of 1957. Corrective steps have already been taken, company officials state.

In the replacement tire market there was increased emphasis on price buying, the company reported. The larger manufacturers, seeking volume, featured lower priced tires. This market trend resulted in lower margins, officials pointed out.

The company's three-year-old plastics division at Newcomerstown, Ohio, almost doubled its 1956 sales. Plastics profits offset a loss for the previous two years, when the division was starting, and 1958 outlook is good. Other divisions also showed increases, the report said. Shoe products sales and earnings were up, and mat sales increased, with earnings slightly off. Export sales and profits were up, and the company's affiliate in Colombia showed a profit.

The report disclosed that Seiberling's investment in Copolymer, carried at $453,998 on the balance sheet, has more than tripled in value since 1955, when the synthetic rubber maker started operations after buying its plant from the government. In addition, cash dividends of $100,000 each were paid in 1956 and 1957.

Discussing outlook, the report noted that other tire makers reportedly are cutting inventories, but said the company, which is primarily a producer of replacement tires, is now increasing production. The company expects to sell more passenger tires and about the same number of truck tires in 1958 as in 1957, and predicts increased sales of shoe products, plastics, and the same number of mats as in 1957. The outlook for earnings is "fairly good" for the year, the report noted, adding that first quarter and perhaps first half earnings would be off because of the Canadian decline.

FINANCIAL BRIEFS

► Keith Powlison, vice-president of Armstrong Cork Co., has sold 2,700 common shares, reducing his direct ownership to 153 shares.

► J. Turner Moore, vice-president of Electric Auto-Lite Co., has reported the purchase of 3,000 common shares. His beneficial holdings now total 7,010 shares.

► J. S. Reid, president of Standard Products Co., has reported the sale of 1,500 shares, reducing his holdings to 89,391.

► Nopco Chemical Co., indirect beneficial owner of more than 10 per cent of the common stock of Brown Rubber Co., Inc., has reported the following purchases: 5,800 common shares through its wholly owned subsidiary, Metasap Chemical Co.; 3,600 common shares through its own offices, and another 2,300 common shares through Metasap, increasing Nopco's holdings to 63,800 shares.

► General Telephone Corp., direct beneficial owner of more than 10 per cent of the common stock of the General Cable Corp., has received 125,000 common shares of General Cable Corp. as a dividend from its subsidiary, Leich Electric Co., increasing direct holdings to 379,000 shares.

Firestone Denies FTC Charges

► Firestone Tire & Rubber Co. of Akron, Ohio, has denied charges brought by the Federal Trade Commission that the company misrepresented facts in its tire advertisements. FTC has charged that Firestone had been advertising second-line tires as first-line equipment. The company misrepresented the facts, FTC declared, when it said that "Firestone Super Champion" and "Firestone Deluxe Super Champion" tires "were original equipment on eight million new cars as they left the factory." In a statement on January 27, 1958, the company replied: "The Firestone advertisements questioned by the Federal Trade Commission are truthful and forthright. We have delivered to the buying public exactly what we have advertised and we are prepared to uphold our position when the opportunity presents itself." FTC claims that the two brands are second-line tires which have never been used as original equipment. A hearing on the matter was to have been held on March 13 in Akron.

Patent Infringement Charged

► Mobay Chemical Co., Pittsburgh, Penna., has filed suit against Hudson Foam Corp., Yonkers, N. Y., for alleged infringement of patent No. 2,764,565. The patent covers processes and apparatus involved in the manufacture of urethane foam products. Mobay, a producer of basic chemicals, does not manufacture the foam itself, but holds a number of patents on machinery and processes used for commercial production of urethane foam.

U. S. Rubber Reports Lower Sales And Profits

► Sales of the U.S. Rubber Co. in 1957 declined 3.1 per cent and net income was lower by 6.8 per cent compared with 1956, according to H. E. Humphreys, Jr., chairman of the board. Net income in 1957 was $29,695,027, which is equal to $4.27 a common share, compared with $31,870,013, or $4.74, a common share, a year earlier. Included in the net income for the year is $3,500,000 which represents profit from the sale of the company's wire and cable business to the Kaiser Aluminum and Chemical Corp. on February 1, 1957.

According to Mr. Humphreys, lower 1957 sales reflected a decline in the sale of tires and other automotive products to car manufacturers; the sale of defense items was lower, and the company sold its wire and cable business.

Profits were lower because of reduced sales volume, he said. In addition, costs were higher because of higher wages and salaries. The company intensified its selling efforts and also stepped up its spending for research and development. Higher selling prices in some lines and economies in operations and administration were not sufficient to offset higher costs Mr. Humphreys added.

Wage and salary adjustments averaging 6 per cent were made effective during the year in most locations of the company. Several increases in employe benefits were also made, highlighted by an improved vacation plan for long service employes, Mr. Humphreys said. The average number of employes in 1957 was 60,136 compared with 63,929 in 1956. Federal and foreign income taxes and renegotiation of government contracts amounted to $25,672,149 compared with $29,732,840 in 1956, he reported.

Net current assets on December 31, 1957 were $282,031,596 compared with $285,788,197 at the end of 1956. Capital expenditures for plant and property expansion and modernization totaled $36,114,930 in 1957 compared with $32,514,229 in 1956. Major new investments were in a new chemical plant at Baton Rouge, La., expected to start production this spring; additional equipment for the production of Trilok fabrics and other textiles, and new tire building equipment. The company also made investments in foreign affiliated companies, principally Englebert S. A., one of the oldest and largest tire manufacturers in Europe Mr. Humphreys reported.

Plymouth Rubber

► Year to November 20, 1957: Net income of $957,591, which is equal to $1.07 a share, compared with $917,004, or $1.05 a share, in the preceding fiscal year.

► Thixon UM-1, a one-coat vulcanization binding agent used to bond polyurethane stocks to metals, is described in a technical bulletin published by the Harwick Standard Chemical Co., 60 S. Seiberling St., Akron, Ohio.

West Coast News

► The technical portion of the February 4 meeting of the Los Angeles Rubber Group, held at the Biltmore Hotel in Los Angeles, Calif., featured an address by Fred W. Gage, technical director of Dayton Chemical Products Laboratories, Inc., West Alexandria, Ohio. Mr. Gage spoke on "Rubber-to-Metal Bonding." The author first reviewed the metals and polymers involved in binding operations at the present time. He discussed various methods of metal preparation in the light of both performance and economics.

The author outlined methods now in vogue for obtaining adhesion between metal and rubber. He made several suggestions regarding modifications in bonding techniques that can be used to improve metal bonding. The testing of rubber-to-metal bonded parts, Mr. Gage stated, still plagues bonding technologists. The author also attempted to explain the discrepancies often encountered between laboratory and factory binding results.

The non-technical portion of the meeting was addressed by Sheriff Eugene W. Biscailuz, who spoke on "Yesterday, Today and Tomorrow in Law Enforcement."

► At a special press conference held on February 26 in Los Angeles, Calif., the Montgomery Ward Co. introduced its new premium nylon passenger car tire featuring a newly developed neoprene sidewall compound. Dr. Edward G. Partridge, director of the TLARGI Rubber Technology Foundation at the University of Southern California, first outlined the problem of ozone attack on rubber products in the Los Angeles area. Two representatives of Montgomery Ward were in attendance to tell of the merchandising problems involved in the marketing of rubber products in the Los Angeles area. Finally, A. J. Hawkins of the DuPont organization, spoke of neoprene, pointing out those properties which make it suitable for sidewall use.

The new tire with its neoprene sidewall compound was specifically developed to combat the severe cracking problem caused by the high concentration of ozone found in the Southern California smog belt. The new tire has been merchandised for about a year and based upon retail sales and adjustment records of 27 stores in the Southern California area, customer complaints of sidewall cracking have been virtually eliminated.

► U.S. Rubber Co. formally opened its new branch in Seattle, Wash. on February 25 with special ceremonies which were attended by H. E. Humphreys, Jr., company president. The new branch has 52,000 square feet of warehouse area and 11,200 square feet of office area. The new facility replaces earlier branches maintained at two other locations in Seattle.

► W. J. Voit Rubber Corp. of Los Angeles, Calif., has announced the purchase of a 37-acre site in South Santa Ana, Calif. Tread rubber and tire repair materials will be manufactured in a 70,000 square foot facility to be constructed on this site this year. Additional space will be added later for the manufacture of the company's line of athletic and sporting goods. When completed, the Santa Ana facility will employ about 700 persons and will replace the company's three present factory sites in Los Angeles.

► Fullerton Manufacturing Co. of Fullerton, Calif., has announced the installation of a new 42 by 42-inch press. The 635-ton unit will handle large oil field parts.

► W. M. Anderson, formerly secretary-treasurer of the Gross Manufacturing Co., Monrovia, Calif., has been elected president succeeding the late D. T. Starr. M. W. Starr has been elected secretary-treasurer of the concern. Mr. Anderson and Roy N. Phelan have been elected to the board of directors.

► R. G. Luskin has been appointed West Coast district manager for the Chemical Division of the Goodyear Tire & Rubber Co. R. B. Williams is now representing Goodyear Chemical in the San Francisco-Bay area as well as in the Pacific Northwest.

► Pittman Products, Inc. of Huntington Park, Calif., has announced the appointment of Art Ireland as chief chemist.

► The Pantasote Co. of Passaic, N. J., has announced the establishment of a West Coast warehouse and sales organization at 2627 San Fernando Road, Los Angeles 65, Calif. The company manufactures coated fabrics, vinyl film and sheeting, etc. The new warehouse will stock all types and finishes of film. Jules Pilcher has been named manager of the West Coast sales organization.

► Miller Rubber Products Co., Los Angeles, Calif., had a disastrous fire on November 13. The company manufactured fatigue mats.

Henley Phenol Derivatives

► A new group of phenol derivatives has been introduced by Henley & Co., Inc., New York, N. Y. The group consists of (1) 4-Tertiarybutyl-phenol; (2) 2,4,6-Tritertiarybutyl-phenol; (3) 2-Methyl-4-tertiarybutyl-phenol; (4) 2-Tertiarybutyl-4-methyl-phenol; (5) 3-Methyl-6-tertiarybutyl-phenol. Available in development quantities, specifications for the new phenol derivatives may be obtained from the company.

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Philadelphia Holds Panel On Use of Textiles In Rubber

► The January 24 dinner-meeting of the Philadelphia Rubber Group held at the Poor Richard Club in Philadelphia, Penna., featured a panel discussion on "The Use of Textiles in the Rubber Industry." Dr. B. S. Garvey, Jr. (Pennsalt Chemicals) served as moderator of the panel discussion. A cocktail hour followed the technical portion of the meeting and this was followed by the serving of dinner. The after dinner speaker was G. M. Koch, manager of Dienelt and Eisenhardt, Inc., Philadelphia, who gave a humorous talk on "Where Are We Going?"

For his part in the symposium, panelist H. R. Schwarz (Wellington Sears), presented a paper entitled "The Use of Textiles in the Rubber Industry." Mr. Schwarz noted that industrial textiles for the rubber trade cover an extensive range of fabric and cord constructions made from both natural and man-made fibers. In fact, he stated, the real start of industrial fabric manufacture coincided with the development of the vast automotive and rubber industries, which today account for the great bulk of industrial textile materials.

The speaker went on to discuss the different types of fibers used in the rubber industry; spun and filament yarns; basic weaves, and woven, kitten and nonwoven constructions. Through the continued cooperative efforts on the part of fiber producers and textile manufacturers, even greater improvements in industrial fabrics for the rubber industry should and can be made in the years ahead, Mr Schwarz declared.

Industrial Products Applications

C. H. Schroeder (Goodrich), chose as his topic for the panel discussion, "Textiles In Industrial Products Applications." Mr. Schroeder noted that the rubber industry has employed textiles for nearly 90 years. Since that time, the textile producers and the rubber manufacturers have come a long way together. The textile industry has designed special materials which have made improvements in rubber products possible. At the same time, advancements in elastomer technology have challenged the textile industry to new developments.

F. J. Kovac (Goodyear), in his paper on "Tire Cord", observed that many of the big improvements in tire performance have stemmed from better tire cords. The speaker discussed cotton, rayon and nylon tire cords and summarized those areas in which rayon is superior to nylon and vice versa. Mr. Kovac also discussed the tire cord of the future, touching upon such materials as wire, aluminum, Dacron, glass and asbestos.

Discusses Tire Cord Progress

"Latex Tire Cord Adhesives" was the title of the paper presented at the panel discussion by E. Leonard Borg (Naugatuck Chemical). The speaker described the first tire cord adhesives and then went on to speak about the problems encountered when rayon cord replaced cotton and when synthetic rubber replaced natural rubber in passenger car tires. Other matters discussed by the speaker included the cold dipping process, dip tank solutions, and measuring the adhesive bond.

D. H. Heckert (DuPont) addressed the Group on "Inter-Industry Cooperation Leads to Better Tires." The speaker outlined his company's activities in the textile field and then went on to discuss the role that nylon is playing in the tire cord market. He pointed out that in 1957, nylon accounted for 35 per cent of the potential tire cord market. Research, he said, will further contribute to nylon's general acceptance in the years ahead.

Following the presentation of the papers, the meeting was opened for questions from the floor.

Small Business Role Vital

► During 1957, E. I. du Pont de Nemours & Co., Inc., bought $860 million worth of materials and services from more than 30,000 different suppliers, most of them small concerns, the company has announced. These purchases, DuPont said, illustrate that DuPont, like most big firms, depends on small suppliers to keep its plants running. The company states "Big companies find they must rely often on the flexibility of the small supplier or service establishment to keep their production lines on schedule." Stressing that big and small businesses are interdependent, DuPont said "On many jobs, for instance, the small local supplier is the only one who is set up to give fast service and at the same time to meet exact requirements."

Panelists at the Philadelphia Rubber Group Meeting.

Styrene Rubber Plant to be Built in Japan

► Japan Synthetic Rubber Co., organized as a semi-government concern in December, 1957, has announced plans to construct a synthetic rubber plant in Yokkaichi, one of Japan's major petrochemical manufacturing centers. The plant is scheduled to start operation by early 1960 with an annual production of 30,000 tons of butadiene-styrene rubber. By the end of its fourth year it is expected that some 45,000 tons will be produced.

Technical "know how" for dehydrogenation, extraction and polymerization processes will be sought from the United States. Negotiations for technical assistance are nearing conclusion with the Houdry Process Corp., Goodyear Tire & Rubber Co., and the Esso Research and Engineering Co. In the first operational year, the plant is expected to turn out 30,000 tons of synthetic including 5,000 tons of latex and 10,000 tons of oil-extended rubber. By the end of the fourth year the oil extended rubber output should be up to 15,000 tons per annum, according to company figures.

The whole project will cost $40 million including construction, equipment, technical aid, and expenses and interest payment during the period of construction. The government is putting up 1,000 million yen of the capital of the company, while rubber manufacturers are providing 1,500 million yen.

The company said it expected an income of 6,200 million yen in the first year of operation. This is expected to grow gradually with the years and after the end of the fourth year it is expected to become 9,400 million yen. Although the first two years will probably end with deficits, the third year of operation should bring profits. By the fifth year of operation, the company hopes to be able to pay about a 12 per cent annual dividend.

Plan New Kawasaki Unit

Aside from Japan Synthetic Rubber Co., which will be the first synthetic rubber manufacturer in Japan, the Japanese Geon Co. is planning to construct a synthetic rubber plant in Kawasaki, a Toyko suburb. Japanese Geon is planning to produce about 8,500 tons of Hycar a year by using techniques of the B. F. Goodrich Chemical Co. of Cleveland, Ohio.

The Japan Synthetic Rubber Co. originally expected to start operating in April, 1959, but the plan was delayed because of a tie-up in the operations of a petrochemical company which will provide raw materials. Consumption of synthetic rubber in Japan has been showing sharp increases with the years. According to reports of the Japan Rubber Manufacturers' Association the figures have increased as follows: 1954—2,100 tons; 1955—4,300 tons; 1956—9,000 tons, 1957—13,500 tons. Production of rubber articles using synthetic rubber will amount to 19,900 tons in 1958, the Association estimates, of which 16,000 tons will be styrene rubber. Automobile tires and tubes will account for more than half of the total consumption.

Canadian News

► Polymer Corp., Ltd., Sarnia, Ont., has announced a 1958 capital budget of $10 million to complete projects underway and to cover initial expenditures for additional expansion intended to increase production, improve product quality, plant efficiency and employee services and safety. The company plans to utilize $7 million for completion of improvements already underway including the research laboratory addition, a new latex plant, expansion of butadiene facilities and improvement of the effluent waste disposal systems. Completion of an additional rubber finishing line has been provided for and the company will also extend utilities and associated services where expanding operations have outgrown existing facilities.

A sum of $3 million has been provided for new projects which include a start on Polymer's new butadiene plant in Western Canada and installations designed to raise the general product level of the plant. Also planned is the improvement of the service and employment facilities and waste disposal systems.

According to the company, these expenditures are intended to protect Polymer's competitive position by assuring an adequate supply of basic raw materials and by enlarging production capacity necessary to satisfy the growing demand for Polymer rubbers.

Polymer was recently hit by a wildcat strike at the Sarnia synthetic facility by 500 maintenance workers who walked out in protest over the firing of a laboratory technician. Spokesmen for members of Local 16-14, Oil, Chemical and Atomic Workers of America, said the strikers were "dissatisfied" with "company high-pressure methods". A union representative said the strike had not been sanctioned.

In another aspect of Polymer activities, the company recently held a banquet at the Sarnia Riding Club in honor of thirteen retiring employees. Honored guests were Joseph A. Willick, Patrick Benware, Thomas R. Stebbins, Edward Thomas, Phillip Harrington, Joseph Schnurr, James F. Brown, Kresten Jensen, John Prisiazny, Arthur McLean, James Ross, Charles A. Purcell and W. Gordon Luckham. L. D. Dougan, vice-president of operations, was chairman and Dr. E. R. Rowzee, Polymer president, spoke on behalf of the management and the supervisory personnel, expressing their appreciation for services to the organization by the retiring personnel.

► Leland E. Spencer, vice-president of the Goodyear Tire and Rubber Co., has been elected executive vice-president of the Goodyear Tire and Rubber Co., Ltd., Toronto, Canada. Succeeding Mr. Spencer, with the title of assistant to the president is Mark W. Laibe, who had been director of purchases for the company. I. S. Gharky, manager of purchasing and materials at Goodyear Atomic Corp., Portsmouth, Ohio, since 1952, has been appointed to the post of director of purchases, succeeding Mr. Laibe.

Mr. Spencer, who has been a Goodyear vice-president since 1956, joined the company in 1926 serving in production operations. Since then, he has served in many capacities with the exception several leaves of absence during which he served with the United States Government, both here and abroad. Mr. Laibe's association with the company began in 1925 in the Purchasing Department, and he has been director of purchases since January, 1952. Mr. Gharky joined Goodyear in 1933 in the company's training squadron and was later assigned to the Purchasing Department as assistant buyer. In 1938, he was named purchasing agent and has since served in a similar capacity in company operations in the United States and overseas.

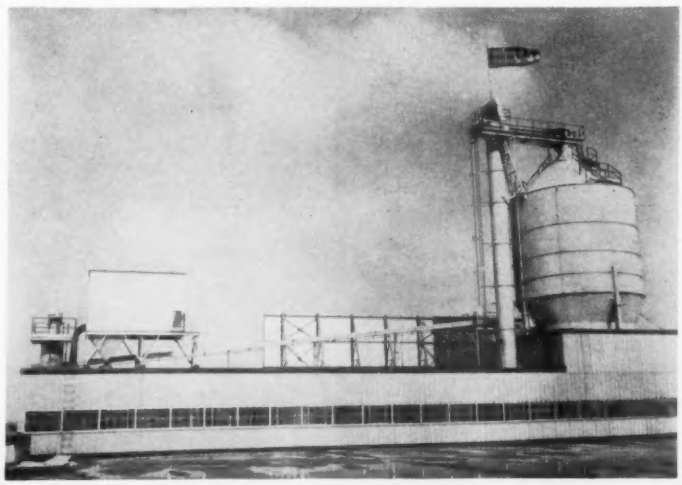
Other company appointments include that of Donald S. Hewitt, who has been named acting manager of the Central Ontario Division, succeeding W. E. Ecclestone, who has been appointed manager of marketing at the company's head office in Toronto. Mr. Hewitt, formerly assistant of the company's London branch, joined Goodyear in 1946 and has served in various sales capacities in Hamilton, Toronto and London. W. M. Ecclestone, manager of the Southern Region for the Central Ontario Division since 1954, has been named assistant manager of the Central Ontario Division. Mr. Ecclestone joined Goodyear in 1946 as a member of the branch staff at Toronto. He became manager of tire sales for the Central Ontario Division in 1951.

A financial report released by Goodyear Canada for 1957, stated that the company had a net income of $4,420,954, the equivalent of $16.07 per common share. This was a decline from 1956 earnings of $6,222,804, or $23.07 a share.

► Canadian Industries, Ltd., has announced that the company's new $9 million anhydrous ammonia plant, located near Kingston, Ont., is now in commercial production. Utilizing the latest industrial techniques for ammonia synthesis, operations at the facility are controlled automatically by instrument panels with vital process controls located on a central control panel. The new plant, believed to be the only one of its kind in Canada which uses fuel oil as a raw material, has a daily production rate of 200 tons.

► Dominion Rubber Co. has announced the appointment of Frank C. Bull as regional credit manager, supervising all credit activities of the company from Lakehead to the Pacific. He will make his headquarters in Winnipeg. Formerly, Mr. Bull was credit manager for the Western Division, with territory extending from Western Ontario to some sections of Eastern British Columbia. A native of Winnipeg, Mr. Bull has wide experience in sales and credit operations.

► Dr. L. P. Moore has been elected president of North American Cyanamid, Ltd., Canadian subsidiary of the American Cyanamid Co., succeeding F. S. Washburn. Dr. Moore was formerly assistant general manager of the parent company's Plastics and Resins Division. Mr. Washburn will continue as general manager of Cyanamid's Phosphates and Nitrogen Division.



► Shown above is the new Whitby, Ont., Canada, operation of Dunlop Canada, Ltd. The multi-million dollar facility is a one floor, 250,000 square foot plant, employing 600 skilled workers. Utilizing the utmost in modern conveying and elevating equipment, the new plant will manufacture tires and foam rubber for distribution in Canada.

SAE-ASTM Technical Committee on Automotive Rubber Meets

December Meeting Covers Wide Range of Subjects

► A report on the meeting of the Technical Committee on Automotive Rubber of the Society of Automotive Engineers and the American Society for Testing Materials, held on December 5 and 6 in Detroit, Mich., has now been made available. The report, prepared by John M. Ball (Midwest Rubber Reclaiming), notes that a great deal of interest exists in an expanded tabular system for ASTM designation D-735. T. M. Loring (Chicago Rawhide), chairman of the subsection in charge of this development, will for the next few months concern himself with the problems of coordinating AMS specifications into the new format. D. E. Manning (Pratt & Whitney), AMS representative, has agreed to assist Mr. Loring. In his report, Mr. Ball states that the larger significance of the new system, that is, its relationship to military specifications, has not yet been clarified.

It was agreed at the meeting that load deflection values for Suffix D are needed for certain classes of materials other than Type R compounds, specifically for silicone compounds, Type T, Class TA. A subsection has been appointed to develop such values for Class TA compounds.

Compression Set Testing

W. H. King (Acushnet Process), chairman of the Subcommittee on Compression Set, reported on the progress his group has made in studying the problems of reduced time involved in compression set testing. Efforts are being confined to active recipes of Classes SB and SC. Various rubber companies will supply one-half inch thick slabs cured from standard production stocks, in the 1500 psi tensile strength grades, in hardness from Shore A 40 through 80.

Test specimens will be cut from these slabs in accordance with ASTM D-395 and tested under three conditions: 22 hours at 158°F.; 22 hours at 212°F., and 70 hours at 212°F. The subcommittee will also include the relaxed compression set method developed some years ago by L. R. Sperberg.

It was agreed that certain data on resilience are also needed, and S. R. Shuart (Enjay) has agreed to provide data on certain low resilience compounds. After study of such data it will be decided whether further work will be needed to continue the study.

On the matter of fluid aging, B. H. Capen (Tyer Rubber) presented results of a survey on the composition of aromatic super premium gasolines, and a proposed program for evaluating the effect of aromatic type fuels on rubber stocks. The subcommittee has found a very high variation with respect to aromatic content, olefin content and saturates content in commercial premium gasolines.

In view of the fact that it is impossible to obtain a standard commercial supertype gasoline, the subcommittee has decided to conduct a round robin on four aromatic fuels of known composition using four different compounds, two from class SB and two from Class SC. These compounds will be tested before and after immersion for 70 hours at room temperature in the four fuels for modulus, tensile strength and elongation. Also, the volume change and durometer hardness are to be determined after drying to constant weight. B. Vandermar (Acadia Synthetic Products) outlined a round robin program for the study of the effect of SAE fuels and lubricants on various polymers.

Mr. Ball reports that on the question of cellular rubber, test methods for vinyl and urethane foams have been drawn up, but have not yet been approved by all parties. The committee under the chairmanship of C. S. Yoran (Brown Rubber) regrets that publication of these methods in the SAE and ASTM handbooks will not be possible.

R. P. Schmuckal (Ford Motor), chairman of the subsection on impact testing, reported that it is the desire of this group to develop test equipment and procedure for small laboratory specimens instead of for full-scale actual production bumpers. The first step, therefore, is to consult with some equipment manufacturing company.

H. Tangenberg (Goodrich), chairman of the subsection on tear testing, reported that this committee is in need of additional data on tear resistance of commercial compounds of various hardnesses, and of accompanying data on other properties including material cost. Various members of Section IV were requested to furnish such data.

Standardization of ozone test boxes was also under discussion at the meeting. M. M. Lowman (Goodyear) chairman of the subsection concerned with this matter, reported that his committee is planning a round robin test. Samples were to have been circulated in February, 1958, together with photographs and complete instructions for carrying out the test. This will involve the testing of two neoprene compounds, both without wax. Cracking will be carried up to a rating of 2 under known ozone box conditions and it is hoped that data will be ready soon.

D. A. Sherman, chairman of the subsection on flexing, reported preliminary flexing data obtained on four compounds by seven different laboratories. Two of the samples were neoprene, both for the same use, and there was general agreement among the various laboratories that by the De Mattia bend test these two compounds had a shorter flexing life than two natural rubber compounds both representing engine mounting formulations.

The various laboratories, however, did not line up the two natural rubber compounds in the same order. Additional results were obtained by the De Mattia extension test and by the Goodrich Flexometer test. The four compounds represented commercial stocks in uncured form which were sent by manufacturers to one laboratory for curing.

So far as the De Mattia bend test is concerned, the following points must be resolved: (1) Should pierced or unpierced samples be used?; (2) Should the end point be kilocycles to 0.5 inches of cracking, or to complete failure?; (3) Should the data be analyzed by use of a log scale for a given number of cycles, or for a given length of crack?

Some Agreement Indicated

The De Mattia extension test results from the two laboratories indicated some agreement even though different speeds were used, namely 60 cycles and 600 cycles per minute. With the Goodrich Flexometer, only two reports were available in which widely different conditions of test were used. Additional data from three more laboratories will be obtained using the same conditions of test. It is hoped that this additional program will be completed in time for the next meeting so that a selection of uniform tests can be made for future work.

H. G. Winter (Cadillac Motor), chairman of the subsection on bond after vulcanization, reported on tests of adhesion values of rubber cemented to steel. Four laboratories conducted these tests using four cements and three rubber compounds varying in wax content. The base compound was SBR 715. With a single exception, adhesion was inversely proportional to the amount of wax. Future work will include different butadiene-styrene rubber compounds, all with no wax. A single cement will be used for this work.

The chairman of the subsection on hose, C. P. Mullen (Gates Rubber), reported that the Ordnance Department is considering the release of ZZ-8-428, a coolant hose system. It has also been agreed that some type of specification for Freon hose should be prepared. As for hydraulic brake hose, the use of materials other than cotton in the manufacture of this type of hose has been reviewed several times, but the decision has been made to remain with cotton reinforcement.

Obituaries

Eric J. Wain

► Eric J. Wain, general purchasing agent of Canadian Industries, Ltd., and president of the Canadian Association of Purchasing Agents, died suddenly in Montreal on February 16 following a heart attack. He was 61 years old. He was born in Bradford, Yorks, England, came to Canada in 1906 and graduated from McGill University in 1922. He served as a civil engineer with the Grand Trunk Western Railway in Detroit and Chicago; Canadian Bridge Co., Windsor, Ont., and the Canada Power and Paper Co., Montreal. During World War I, Mr. Wain served overseas with the Royal Air Force. He was elected president of the Canadian Association of Purchasing Agents in 1957 prior to which he had served as treasurer, vice-president and president of the Purchasing Agents Association of Montreal. He was a member of the recent Canadian trade mission to Great Britain. Mr. Wain held directorships in the North American Accident Insurance Co., and the Royal Guardians, and was chairman of the finance committee of the Canadian Handicrafts Guild from 1934 to 1947.

Elmer Carling

► Elmer Carling, sales manager of the Pigments Division, American Cyanamid Co., New York, N. Y., died on January 19 after a short illness. He was 48 years old. A native of New Jersey, he was a graduate of Newark College of Engineering. He spent his entire business life in the Pigments Division of American Cyanamid and its subsidiaries. He established the Eastern regional sales office in 1947 and was named assistant sales manager of the Pigments Division in 1949, rising to the post of sales manager in 1954. Mr. Carling was a member of the New York Paint, Varnish & Lacquer Association.

Lee A. Keane

► Lee A. Keane, retired vice-president of U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., died on February 7 at his home in New Canaan, Conn. He was 63 years old. Until his retirement in November, 1956, he had been U. S. Industrial Chemicals vice-president in charge of sales for a period of 20 years. Previous to that, he had been associated with Faultless Rubber Co., and the Goodyear Tire & Rubber Co. A native of Atwaters, N. Y., Mr. Keane was graduated from Cornell University and was a lieutenant with the Chemical Warfare Section of the United States Army during World War I. He is survived by his wife and a son.

Harold L. Jungmann

► Harold L. Jungmann, Eastern sales manager of the Titanium Pigment Corp., subsidiary of the National Lead Co., New York, N. Y., died on January 26 after a long illness. He was 56 years old. Born in St. Louis, Mo., he was graduated from the University of Illinois in 1924 with a degree in chemical engineering. He had been with Titanium Pigment all of his business life, starting in the St. Louis plant and later transferring to the Chicago sales office. In 1948 he moved to New York and in 1955 became Eastern District sales manager. He was a member of the New York Paint, Varnish & Lacquer Association and the Bankers Club of New York. He is survived by his wife and a son.

George D. Sheffield

► George D. Sheffield, purchasing agent for the New York Rubber Corporation, died on January 24 in Vassar Hospital, Poughkeepsie, N. Y. He was 47 years old.

Reorganizes Sales Force

► Davis-Standard Division, Franklin Research Corp., Mystic, Conn., has announced that it has enlarged and strengthened its sales force to provide greater customer service and broader coverage of the extrusion sales field. Philip Greene, sales representative in the New Jersey New York and southwestern Connecticut area, has been appointed sales manager for Davis-Standard. The wire and cable accounts in this territory will now be handled by John McCormick, a new company representative. Louis Dziedzic will cover the southern states, while Erle Morgan has been assigned the territory of Connecticut, western Massachusetts and the upper Hudson River area. Marcus Jones and Douglas Laplant have been designated as service representatives. Appointment of the E. V. Larsen Co., Ltd., Toronto, as Canadian sales representative will now permit Norton C. Wheeler, Jr to concentrate his time and efforts solely within the New England area and upper New York State.

Fort Wayne Holds Panel

► Approximately 200 members and guests of the Fort Wayne Rubber & Plastics Group attended the third meeting of the 1957-58 season which was held on February 13 at the Van Orman Hotel, Fort Wayne, Ind. The meeting featured a panel discussion on "Factors Affecting Quality in Plastics Extrusion" presented by members of the Extrusion Process Group, Development Department, Bakelite Co., Bound Brook, N. J. Peter Wilton served as moderator. The other panel members included Bruce H. Maddock, Bernard Zurkoff and Henry J. Nalepa. After an introduction by Mr. Wilton, Mr. Maddock spoke on the "Theory of Mixing." Mr. Zurkoff followed with a paper on "Application of Controlled Pressure (Valve) Extrusion Principle to Product Extrusion-Impact Polystyrene and Polyethylene Sheet." For his part in the panel discussion, Mr. Nalepa spoke on "Vinyl-Dry Blends (Wire Coatings)." At the conclusion of their talks, the panelists answered questions from the floor.

Elected AMF President

► American Machine & Foundry Co., New York, N. Y., has announced the election of Carter L. Burgess as president. Mr. Burgess, formerly president of Trans World Airlines, was Assistant Secretary of Defense for Manpower and Personnel from 1954 to 1956, receiving the Defense Department's highest civilian award, the Certificate of Appreciation. He served the General Aniline and Film Corp., from 1947 to 1953, in an executive capacity. Mr. Burgess was Deputy Executive Secretary of the International Secretariat at the United Nations Conference at San Francisco in 1945. He is a director of American Machine & Foundry and of J. P. Morgan & Co. Mr. Burgess was formerly a member of the Board of Governors, American Red Cross, and of the Board of Directors, United Service Organizations, Inc.

EMA Officers Elected

► Electrical Manufacturers Association has announced that B. F. Isley of the General Electric Co. has been elected chairman of the Association's Wire and Cable Section. The Section also re-elected David E. Allen, vice-president of sales of the Anaconda Wire and Cable Co., and H. B. Bassett, president of the Acme Wire Co., as its two vice-chairmen for another term.

Acquires Insular Chemical

► Rubber Corp. of America, New York, N. Y., has acquired the Insular Chemical Corp., from the Pollak Industrial Corp. Insular, a manufacturer of polyvinyl chloride resin at its Hicksville, Long Island plant, becomes a wholly owned subsidiary of Rubber Corp.

Penn-Texas Sells Crescent

► The board of directors of the Penn-Texas Corp., New York, N. Y., have approved the sale of the Crescent Co. of Pawtucket, R. I., to Milton C. Sapinsley for $1,100,000 in cash. The sale included the Lowell Insulated Wire Co., a subsidiary acquired by Crescent in 1956. Both Crescent and Lowell manufacture insulated wire and cable. Mr. Sapinsley, founder of the Crescent Co., sold the firm to Penn-Texas in a $1,800,000 stock transaction in 1953. Crescent was established in 1920 and expanded from automotive and radio wire and cable into a complete line of electrical, automotive, welding and mining machine cables. Mr. Sapinsley is chairman and treasurer, and his son, John M. Sapinsley, is president, posts which they held prior to and during the period when the company stock was owned by the Penn-Texas Corp.

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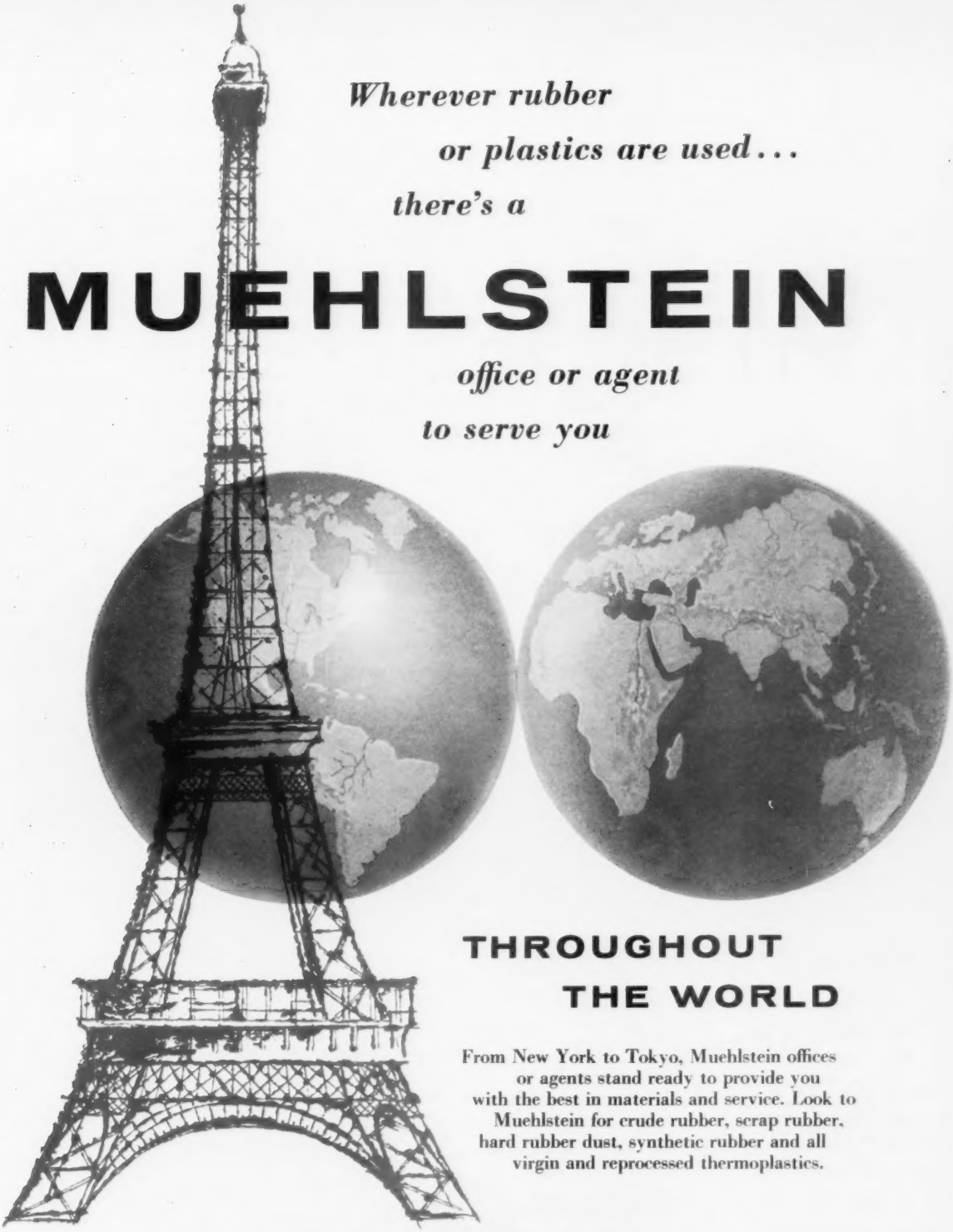

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Brussels—The director general of the Food and Agriculture Organization of the United Nations has been requested to take steps to stabilize the prices of plantation crops such as rubber and tea in a joint letter by the general secretaries of the International Confederation of Free Trade Unions and the Plantation Workers' International Federation.

Kuala Lumpur—Legislation is being prepared to put Malayan natural rubber in a stronger position to compete with synthetic. It is believed that the legislation will provide for the appointment of a controller of rubber research, who would be independent of the government, and a ten-man body, nominated by industry and government, to control allocation of research money.

Dusseldorf—A synthetic rubber plant being built by Bunawerke Huels Co. is scheduled to start production in May with an annual capacity of between 45,000 and 50,000 tons. The new plant will produce synthetic cold rubber under the name "Buna Huels KKK".

Djakarta—The Indonesian Foreign Exchange Institute has reduced the bank guarantee for rubber exports. Traders previously obliged to deposit twenty per cent of the value of rubber exports with the banks, must now deposit ten per cent. The guarantee would be forfeited if traders failed to export rubber.

London—Thirty-three varieties of high yielding rubber trees have been introduced into Dunlop's plantation around Calabar in eastern Nigeria. Of 20,000 acres acquired by the company, 5,000 have been cleared, most of which have been planted with seeds of high yielding species.

Kuala Lumpur—The Rubber Producers Council, in its annual report, said 1958 can not be regarded with confidence owing to the world-wide depression in commodity prices. This has already resulted in decreased output of Malayan tin and might mean a lower level of market prices for natural rubber over the years, the report said.

Paris—Kleber Colombes, French rubber producer, is increasing its capital from 4,750 to 5,700 million francs by a new cash issue of 190,000 new 5,000 franc shares issued at 5,500 francs, bearing interest from January 1, 1958 and restricted to holders on a one-for-five basis. Kleber Colombes, one of France's largest manufacturers of industrial rubber and a leading tire producer, is linked by technical agreements with the B. F. Goodrich Co.

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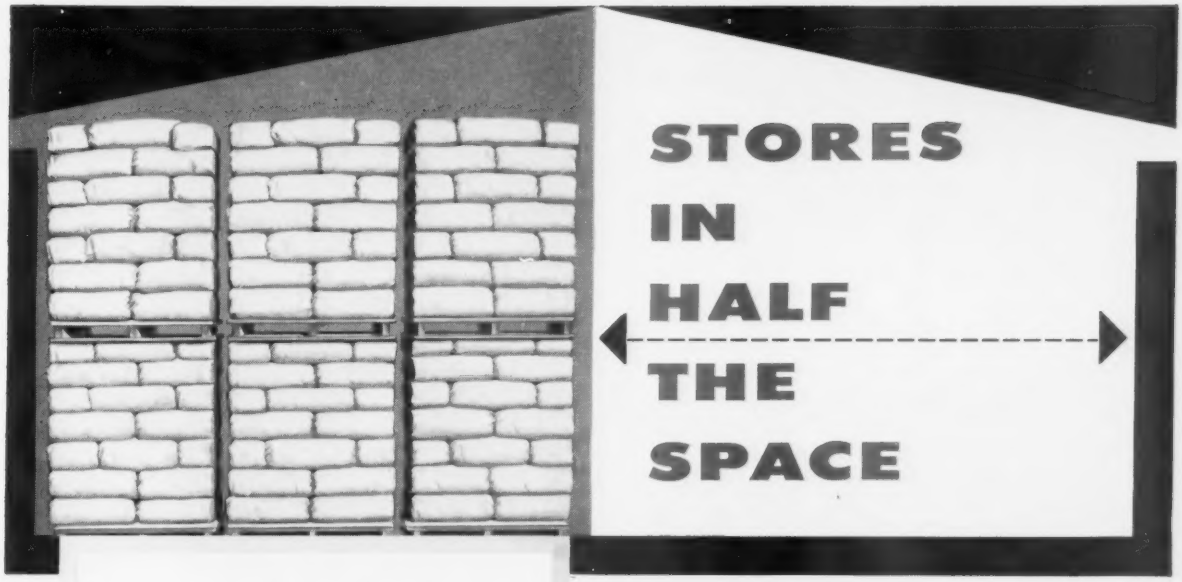

HERE ARE OTHER IMPORTANT REASONS WHY AZODOX IS BEST FOR YOU

Increased Mixing Capacity. AZODOX incorporates readily, disperses completely in both hard and soft stocks, at high or low concentrations, on the mill or in the Banbury. No hard-crusted agglomerates are present in AZODOX to cause mixing and dispersion difficulties.

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Flows More Freely, Less Dusting than conventional zinc oxides.

AZODOX Cuts Your Costs. Faster handling, easier storing, quicker mixing save you money.

AZODOX is factory-tested and proved. Now available in sample lots or carload quantities for your use *at the same price of conventional zinc oxides.*

AZODOX available in surface treated form if desired.

AZODOX is a revolutionary new form of zinc oxide (de-aerated). With twice the density, half the bulk of conventional zinc oxides, AZODOX is the answer to your storage problem. AZODOX comes to you in an easy-to-handle small package, shaped to permit closely packed, unitized shipments. *And the perfect texture of the material remains unchanged.*

AZODOX is available in all grades of American process lead-free zinc oxide.

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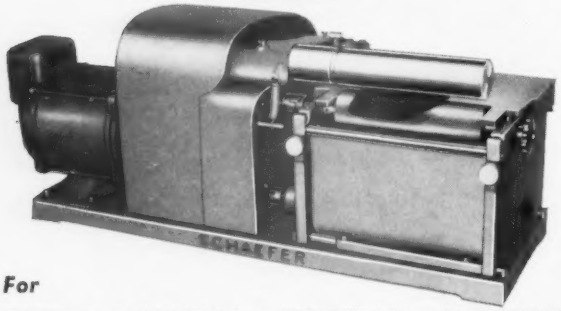

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OVERSEAS (CONT'D)

Tokyo—The Japanese Synthetic Rubber Co., a recently formed semi-governmental concern, intends to build a plant for the production of styrene-butadiene rubber at Yokkaichi in central Japan. It is hoped that operations will start early in 1960 at an initial production rate of 30,000 tons rising to 45,000 tons by 1964. Technical "know how" would be supplied by the United States.

Bombay—A new rubber tire factory, called "Ceat Tyres of India Limited", is to be started in Bombay by the Indian Tata concern in collaboration with the Italian industrial firm of Ceat SPA. The new company will have an authorized capital of 40 million rupees and a paid-up capital of 11.5 million, of which 60 per cent would be subscribed by the Italian company.

Moscow—A substantial extension of Russia's synthetic industry is planned for 1958, according to M. K. Baibakov, planning chief of the Russian Federation of the Soviet Union. He said capital investments in the synthetic rubber industry will be increased by 83 per cent during the year.

Copenhagen—The Parliamentary Committee has recommended that Danish import duties on tires for tractors and trucks be suspended, while duties on tires for other cars be reduced from 80 to 50 oere per kilo, after consideration of the recent proposal by the Minister of Finance asking for a duty relaxation.

Kuala Lumpur—A spokesman for the Malayan Ministry of Commerce and Industry said recently that Malaya would start manufacturing a wider variety of rubber goods within the next few years. He was commenting on remarks by two visiting Brazilian industrialists, who were surprised that Malaya did not have a wider range of rubber products when the raw material was at hand.

Singapore—Production of natural rubber is unlikely to increase in the next few years and might decrease in Indonesia, according to a forecast by Lewis and Peat (Singapore) Ltd., in their review of the local rubber market during the second half of 1957. The report said that the synthetic rubber industry is making progress and new plants are being built in Europe and Japan.

Kaula Lumpur—The Chairman of the Malayan Rubber Producers' Council has denied that big European rubber firms are "pulling out of Malaya", refuting a rubber review published recently by the Associated Chinese Chambers of Commerce. He said a multi-million dollar re-planting scheme by European estates in Malaya is proof of their faith in the country.

London—Dunlop Rubber Co. has entered into an agreement with Sociedad Iberica de Gomas y Amientos S A, Bilbao, whereby Dunlop will provide technical aid in products already manufactured by SIGA. In part consideration, Dunlop will ultimately acquire a 20 per cent interest in SIGA.

A hose that takes extremes of heat and cold without cracking; attachable tire sidewall rings in white and a variety of colors for *extra* beauty in today's cars; and boots with superior resistance to weather and wear . . . all through the use of Enjay Butyl.

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New Goods

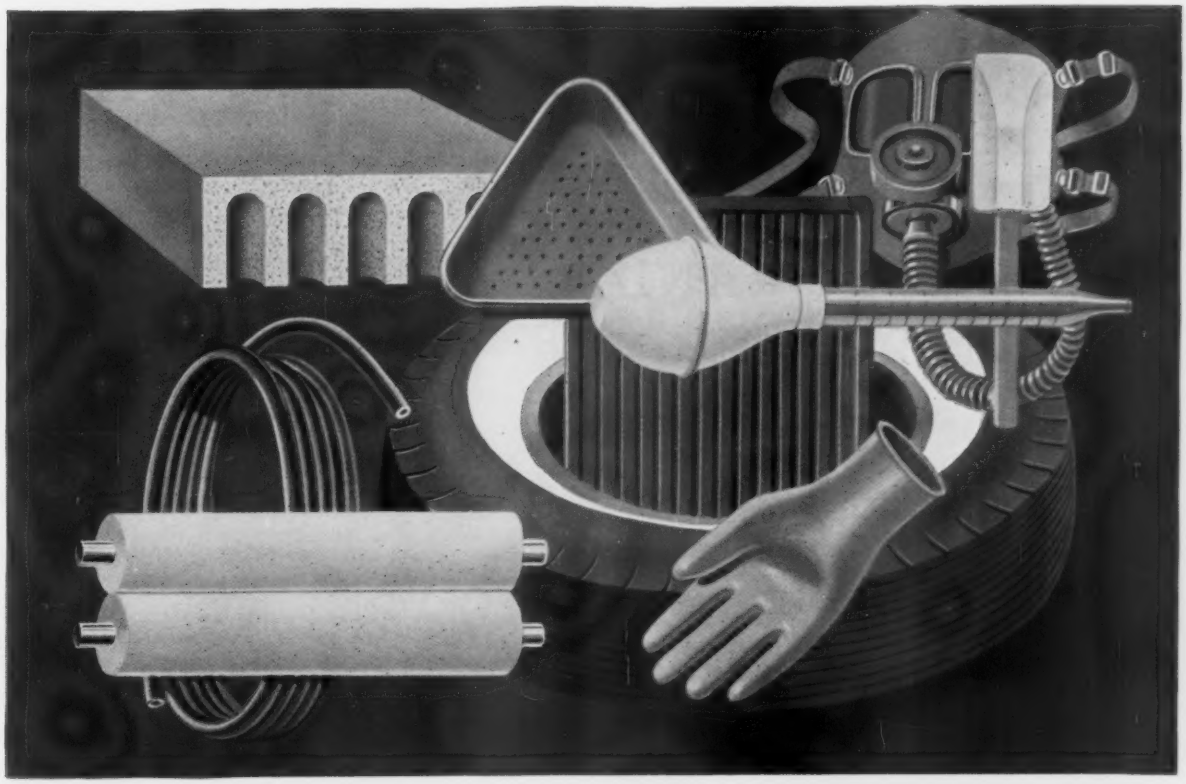
Goodrich Road Expansion Joint

► Development of a unique rubber expansion joint designed to eliminate the rhythmic road shock motorists encounter on many highways and to make aircraft landings smoother on airport runways has been announced by B. F. Goodrich Industrial Products Co., Akron, Ohio. The company stated that this is an entirely new concept in rubber expansion joints, permitting as much as three inches of contraction and

expansion in the highway or runway while keeping the rubber flush with the surface. The joint is made of synthetic rubber specially compounded to absorb movement of the highway in cold or warm weather. Metal plates are bonded in series to the rubber to carry the vertical loads imposed on the joint by traffic. Anchored between road sections for a water-tight seal, the joint is about 13 inches wide, and extends the width of the highway or runway and fully fills the joint connection to its required depth. The ability of the rubber joint to absorb the expansion-contraction of the highway permits use of fewer joints under new highway engineering concepts. Originally developed for new pre-stressed concrete highways, the rubber expansion joint is also being designed for use on bridges and bridge approaches. The Federal Highway Construction Program has expressed interest in the new joint and a number of states are planning to use it in experimental highway sections.

Minnesota Double-Coated Tape

► Double-coated paper tape, with a high strength rubber adhesive on both sides, has been introduced by the Minnesota Mining and Manufacturing Co., Minneapolis, Minn. Designed to mount rubber printing plates and to secure glass in metal door and window frames, the tape bonds firmly to natural and synthetic rubber as well as to glass, the company states.



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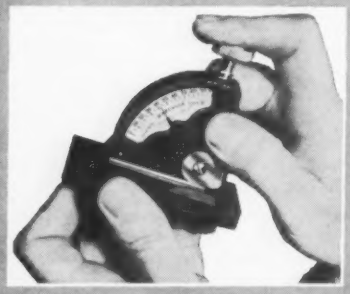

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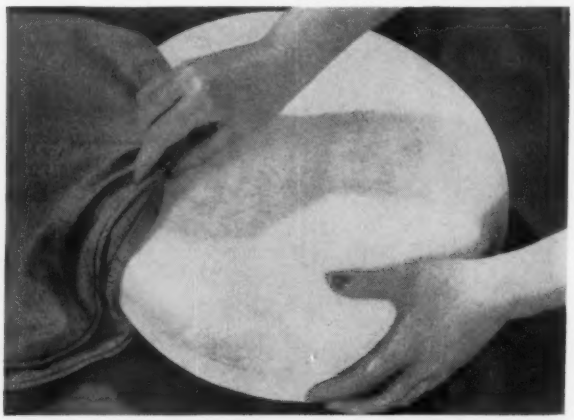
Manufacturers of the "Scleroscope," for testing the hardness of metals.

Cambridge Vinylfoam Cushions

► Developed by the Cambridge Rubber Co. of Taneytown, Md., a new line of Vinylfoam throw cushions may be covered easily at home. The pillows, either square or round, are made under the Elastomer Process, and are said to be flame, moisture, mildew and moth resistant. The foam is dimensionally stable, retaining its molded



contours and superior tensile strength under normal atmospheric conditions. Two halves of the molded sections, internally cored as part of the molding process, are laminated together to form a single unit with smooth surfaces that slip easily into any type of cover. The pillows are made in 12 and 14-inch sizes, approximately 4½ inches at the crown, and 2½ inches high at the box, are non-allergic, sanitary and durable, Cambridge states.

Goodrich Extrawear Heel

► B. F. Goodrich Industrial Products Co., Akron, Ohio, has announced the production of a new rubber heel for men's shoes designed for use by both shoe manufacturers and the repair trade. The new heel, called "Extra-

wear", is said to be of modern design and is made with either contrasting or matching inserts. It is a companion item to the company's "Extrasoft" heel. The Extrawear heel is being offered as a complete line in non-marking black and brown colors.

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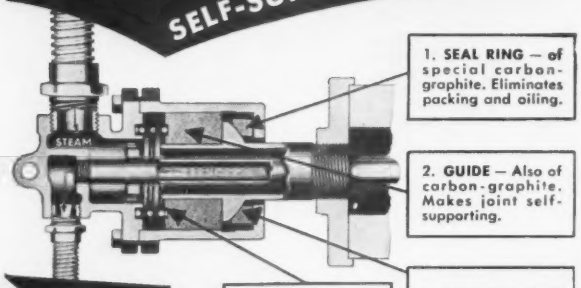
JOHNSON Rotary Pressure JOINT
SELF-SUPPORTING TYPE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Type SB shown handles both steam and condensate through same head; also available for through flow service, and in sizes and styles for all operating conditions. ***Write for literature.***

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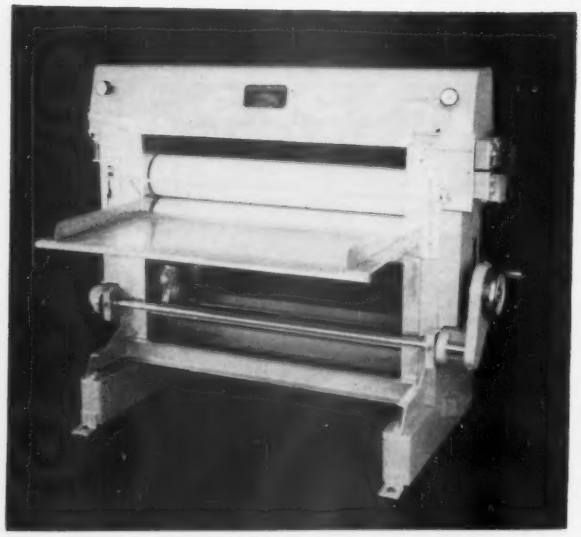

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Vinyl Covered Play Pen

► Trimble, Inc., Rochester, N. Y., has announced a new fashion in play pens utilizing a heavy-duty vinyl sheeting as a cover for the top rails and the reversible floor pad. Combining modern design with safety, the "Trimble Kiddie-Yard" features an enclosed play area

40 by 40 inches, folding to a width of 5½ inches when not in use. Weighing approximately 25 pounds, including the reversible floor pad, the inside depth of the pen is 22 inches and the height off the floor is nine inches. Tough knitted nylon encloses the play area, allowing plenty of visability and supplying a web of safe hand holds for baby to grasp when learning how to walk or stand. Flexibility of the netting is said to permit folding while toys and pad are still inside the pen, company officials state.

Novabestos Sheets And Tapes

► Asbestos Textile Division of Raybestos-Manhattan, Inc., Manheim, Penna., has developed a new line of silicone rubber coated "Novabestos" sheets and tapes for use as primary and secondary insulation in shipboard cables and other types of power cables. The tapes and sheets, supplied in two styles "7526" and "7527", are said to withstand greater shock vibration and abuse than glass-cloth-base tapes and to provide 15 to 30 per cent savings in unit-area cost. According to the company, they have excellent resistance to dry baking heat, good oil and moisture resistance, and the insulation stays together after severe flame exposure. Style 7526 Novabestos is supported with parallel strands of glass yarn which provide a unidirectional tensile of 75 pounds per inch of width. Style 7527 is reinforced with a glass scrim, which provides a lengthwise tensile of 75 pounds and a crosswise tensile of 50 pounds per inch of width. The first can be overlapped, while the latter must be butt wrapped.

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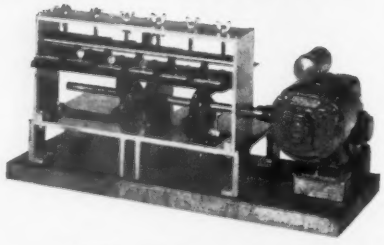
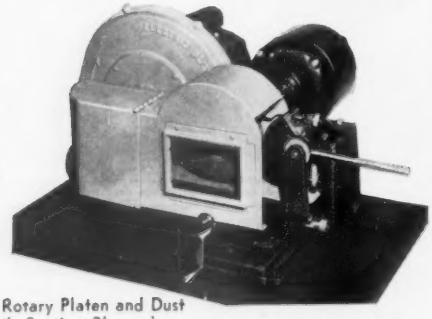


RUBBER SAMPLE BUFFING MACHINE



(Shown with Rotary Platen and Dust Collector with Suction Blower.)

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183 Tremont St., Melrose, Mass.

Seven New Rubbermaid Products

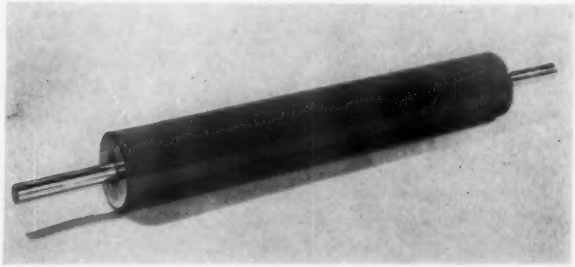
► Wooster Rubber Co., Akron, Ohio, has introduced seven new Rubbermaid housewear products. The first of these consists of three bowls made of what is said to be an unbreakable, easy-to-clean, non-porous, lightweight plastic. Named the "Rubbermaid Mixing Bowl Set", the bowls are sized for all kitchen jobs and have wide pouring lips to guide liquids and prevent spillover. The company states that they are stain-proof, non-toxic and will hold boiling water. A "Plate and Bowl Anchor" made of a special rubber compound, is provided with each set to hold the bowls firmly in place during use. The "Rubbermaid Round Bucket" has been reinforced under the rim with a heavy wire to support the metal handle and prevent buckling under heavy contents. The bucket has twin pouring spouts, and recessed bottom grips.

Manufactured in unbreakable plastic, the "Rubbermaid Tissue Dispenser" has an expanding top that slides down over any size or brand of tissues. The product is said to work as easily with tissues that are dispensed from the center of the package as those pulled from the edge of their containers. Colors are yellow, pink, turquoise, white and light green. Wooster's "Laundry Basket" is rectangular in shape, has rotating flush handles and a non-snag finish. A rim wire holds the basket rigid. A new, cushioned "Toilet Top Tray" is said to be unbreakable and to fit all toilet tops. Featuring a sun-burst design, the tray has a high rim to prevent spilled liquids from dripping.

Designed as an extra waste-basket for bedroom, bathroom, playroom or nursery, the "Rubbermaid Vanity Wastebasket" has an arched bottom for easy sliding and neat appearance. It is 10 x 6¾ x 10½ inches in size. The company's new one quart container called the "Dial-It Dispenser" has a dial top to regulate flow. The spill-proof lid has a pouring spout which screws on.

Luzerne Rigid PVC Roll Covering

► Luzerne Rubber Co., Trenton, N. J., has announced the development of what is said to be a new and unique process which has made possible the use of rigid PVC

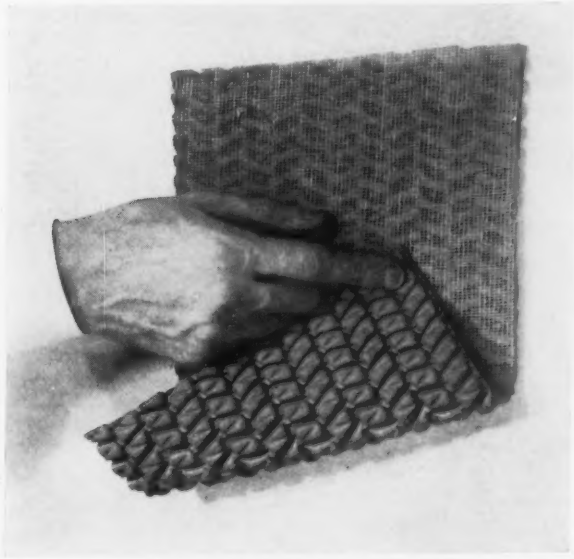


for roll covering. In a controlled Luzerne process, special PVC tubing is shrunk tightly over new or old rolls, providing a strong mechanical bond. According to the company, economy, versatility and the physical and chemical properties of this outstanding plastic are major features of these coverings.

NEW USES

Plasticizer for Blown Sponge Rubber

American Cyanamid's Pepton 22® plasticizer is finding wide usage in products such as blown sponge rubber mats and rubber rug underlay, now rapidly increasing in popularity as replacements for felt under large rugs. A non-staining peptizer, Pepton 22 facilitates mastication in the mixing operation and provides softer, smoother, more plastic mixes. This outstanding plasticizer will not discolor white or light-colored stocks and has no adverse effect on aging. It has also proved highly effective in reducing breakdown time by as much as 50%, resulting in increased production and savings in power requirements. Full technical information on Pepton 22 may be obtained from American Cyanamid Company, Rubber Chemicals Department, Bound Brook, N. J.



MBTS Pellets Aid Automatic Compounding

Unimpeded movement of materials is extremely important in automatic compounding . . . uniformity of operation demands free flow and minimum dusting. Cyanamid's Rubber Chemicals Department has now developed MBTS pellets, a product combining the maximum in free-flowing properties with the minimum in dusting. Large-volume producers of tires, car mats, tile and similar products will benefit through increased operating efficiency, good dispersion, materials saving and more pleasant working conditions.

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Dethroned as primary accelerators in the early 1930's, the diaryl guanidines such as Cyanamid's DPG and DOTG quickly found a new place for themselves as activators or secondary accelerators for the thiazoles which replaced them. They play a valuable part in both natural rubber and butadiene-styrene copolymers, particularly in the latter where the cure is slower. The guanidines assist in balancing cure characteristics and give improved physical properties during early curing stages of such items as footwear, tires, hard rubber and molded goods in general.

PEPTON® 22 PLASTICIZER

in regular, cold or oil-extended SBR, in natural rubber . . . or mixtures

It's *all* benefits with PEPTON 22 Plasticizer—easier processing, more thorough mixing, and homogeneous milled stocks which mold or extrude well.

There's *no* discoloration, *no* bloom and *no* effect on aging characteristics.

Depending on the type of stock, just add from 0.5% to 3.0% of PEPTON 22 within a minute after loading the mill or Banbury. It quickly dissolves in the polymer to produce a highly plastic, crumb-free mix with high-grade processing qualities.

Formulation possibilities—and results—are thoroughly explored in Cyanamid's Technical Bulletin No. 816, PEPTON 22. Request a copy and check the possible applications in your own compounding for PEPTON 22 . . . the plasticizer developed after years of Cyanamid research.

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Rubber Chemicals Department
Bound Brook, New Jersey

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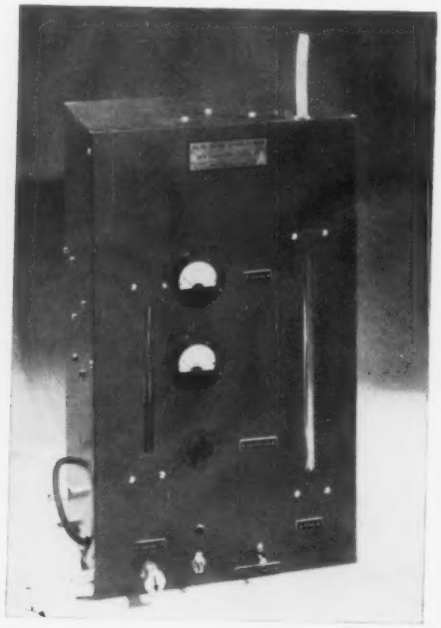
New GFB Ozonator

► GFB Ozonator Model B.2 for testing the resistance of rubber to cracking by large ozone concentrations is produced by G. F. Bush Associates, Box 175, Princeton, N.J. Suitable for use in ASTM Test D-1352 for evaluations



of butyl rubber and similar elastomers, the ozonator is designed to generate, maintain and measure a continuous flow of specially generated ozonized air under controlled temperature and flow rate through a specimen exposure chamber. The generator is designed for concentrations usually above 0.01% by volume; its maximum is about 0.05% under optimum conditions. Concentration is occasionally checked by improved chemical analysis, for which complete built-in apparatus is supplied with the model.

Denison Vane Pumps

► A new series of balanced vane hydraulic pumps for continuous 2000 psi service has been announced by Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. Known as the "T" series, these pumps are of special construction featuring Denison's exclusive hydraulically balanced vane, said to insure continuous high efficiency. Pumps are available supplying rated deliveries of up to 100 gallons per minute at speeds up to 1800 rpm. They are said to be useful for special machinery such as extrusion presses where 2000 psi pumps require less space to pack more power and provide greater operating efficiency.

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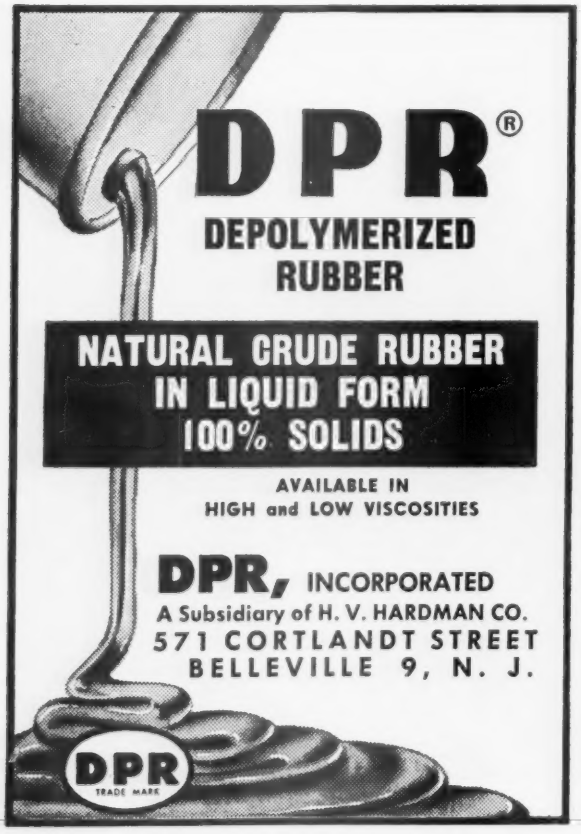
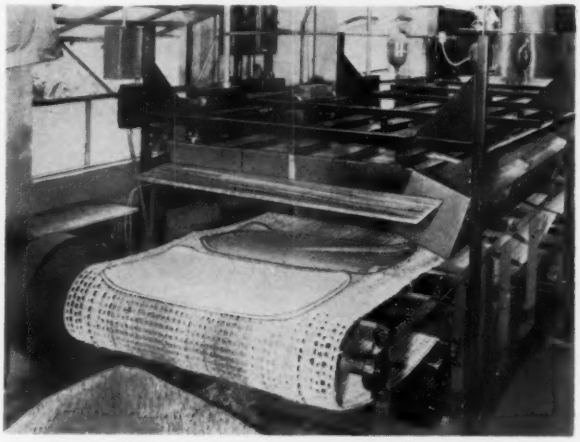


Electric Infra-Red Oven

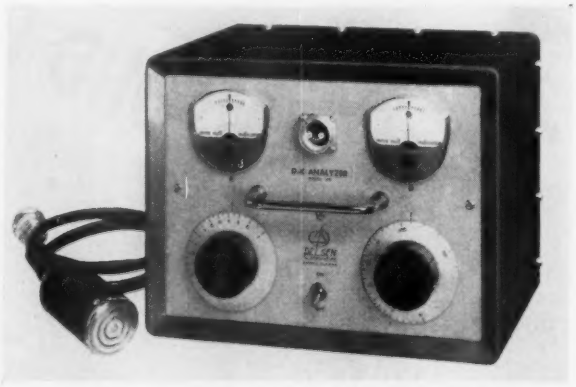
► A 21-foot electric infra-red oven manufactured by Dry Clime Lamp Corp., Greensburg, Ind., is said to dry liquid synthetic latex sprayed on the back of rugs in



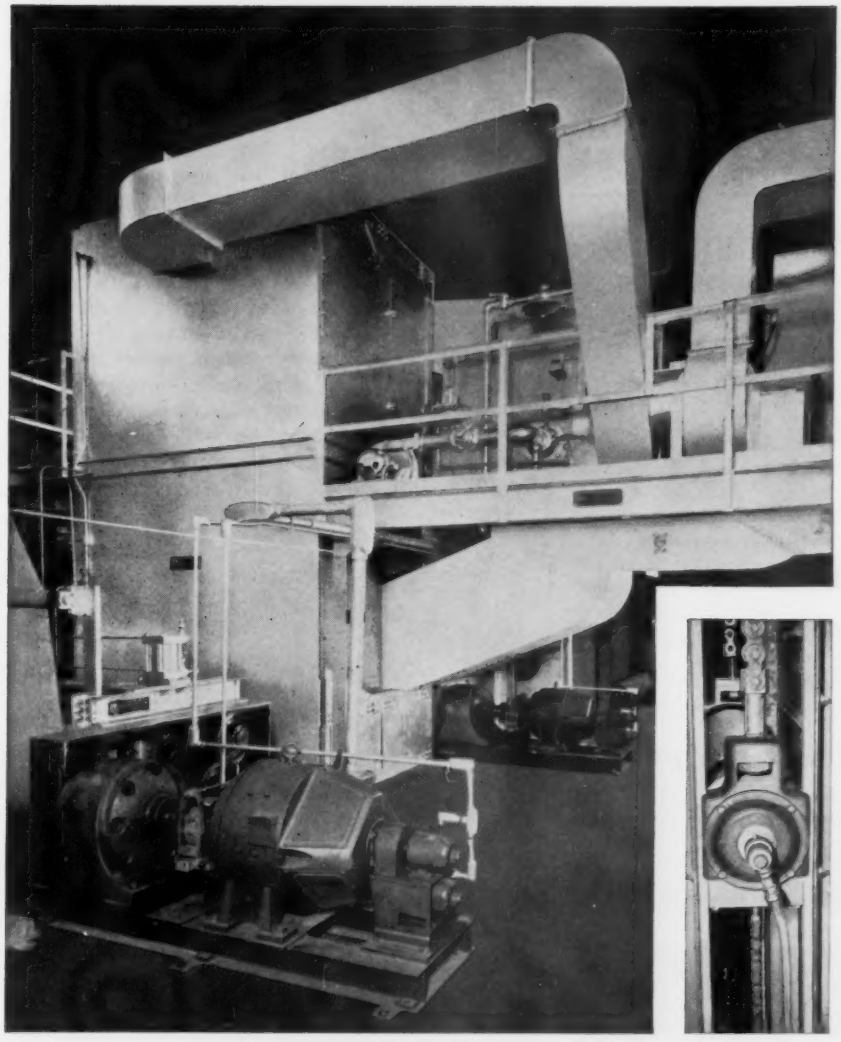
approximately 2½ minutes. Two temperature controls which may be set at any heat level from 0 to 100 per cent of rated capacity are designed to maintain heat on the surface of the rugs. The DriQuik oven, as it is called, has no bulbs or quartz tubes which burn out, but employs heavy-duty lava-coated ceramic type infra-red generators that do away with bulb, tube and socket replacement costs.

Delsen D-K Analyzer

► The Delsen D-K analyzer is a portable, non-destructive, direct reading instrument which measures the dissipation factor and dielectric constant of insulating ma-



terials. Manufactured by the Delsen Corp., 719 West Broadway, Glendale 4, Calif., the instrument can be used to investigate the effects of variables such as hardeners, fillers and cure conditions in dielectric systems, as well as other applications. It is available as a battery operated unit or as a laboratory instrument with a plug-in power supply.



◀ Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI** Rollevator® Oven*, was made into aircraft tires meeting all qualification tests.

◀ The Rollevator® roll automatically moves up and down within the oven, in direct relation to line speeds. Thus, at *any line speed, heat-exposure* time of the nylon is held *constant* at a constant temperature setting and at constant tension.

Rollevator® Oven* hot stretches nylon tire cord at constant optimum temperature, constant time and constant tension, at variable line speeds

The IOI Rollevator® Oven* is the answer to more uniform hot stretching of nylon with greater production efficiency. Simple and automatic in operation, it practically eliminates costly shutdown and repair time. When the line is stopped the Rollevator® roll automatically lowers out of the heat zone, eliminating the need for quick cool purging of the oven and the time and expense involved in reheating the oven when starting up again. Its low operating cost combined with low initial cost assures you of lower production cost. An IOI sales engineer will be glad to give you complete information about the Rollevator® Oven* and to discuss your requirements for any system from 3 to 100 yards per minute.

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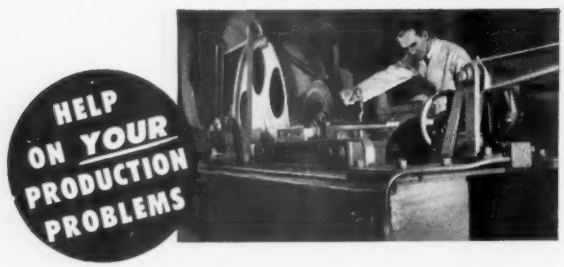

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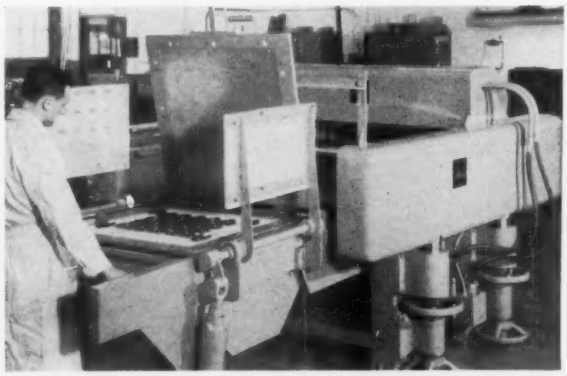
Automatic "Roll Lift" Trimmer

► Double impression cutting is eliminated and die life is doubled by a new "roll lift" feature which Falls Engineering and Machine Co., 1734 Front St., Cuyahoga Falls, Ohio, has built into its newest automatic trimmer for molded rubber goods. When the roll traverses the die, making the trim or necessary cuts, the new feature automatically lifts the heavy roller off the die and it idles back to the starting position, instead of rolling back over the die as was the case in earlier models of the automatic trimmer. This means greater accuracy in cutting, Falls Engineering officials point out, because a double impression may be off register. Die life is doubled because the number of impressions of the heavy roller against the die is cut exactly in half with each operation.



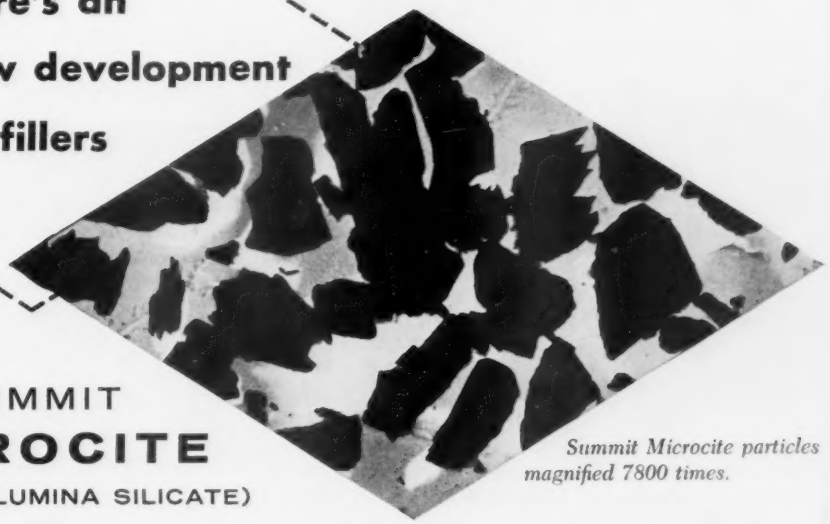
Designed by Campbell Machinery Development Co., the new automatic trimmer will handle entire sheets of mechanical molded rubber goods on an around-the-clock basis, the company reports. It is equipped with a motorized traversing steel roll assembly which provides the cutting pressure on clam shell dies. The dies are locked in two frames, one upper and one lower. The sheet of molded rubber goods, direct from the curing press, is placed on top of the die in the lower frame. The operator pushes a button and the upper and lower dies close against the stock. Then the traversing roll makes the cut and passes to the far end of the machine where the roll is automatically "lifted" and idles back to starting position ready for the next cut on another piece of stock.

As the cutting roll returns to its original position, the dies are automatically pulled from the trimmer bed and opened. Scrap rubber is removed by the operator and the lower die upends to discharge the trimmed parts. At this point right and left-hand knock-out assemblies jar the trimmed goods loose from the die and they drop into a tote box or take-away conveyor.

The only manual operations required with this machine are loading the dies and removing the scrap. The trimmer will handle a sheet of molded rubber goods to a maximum size of 30 x 30, and it occupies floor space approximately 8 x 12 feet.

The new automatic trimmer develops cutting pres-

Here's an exciting new development in fillers



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By origin, Summit MICROCITE is a hydrous alumina silicate, double air classified and processed to a low particle size and high surface area. It is chemically inert, and neutral with a pH of 6.8. Because of its non-hygroscopic properties, MICROCITE will not absorb moisture (controlled to under ½ of 1%). It wets almost instantly in water and disperses to a moderately stable suspension. It has free flowing characteristics in its fine powder form and will not cake or coagulate in storage.

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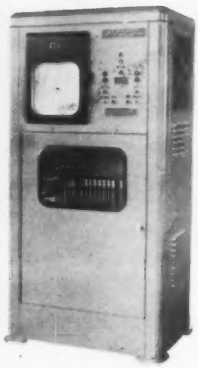

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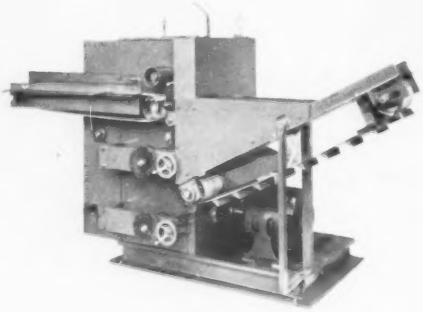

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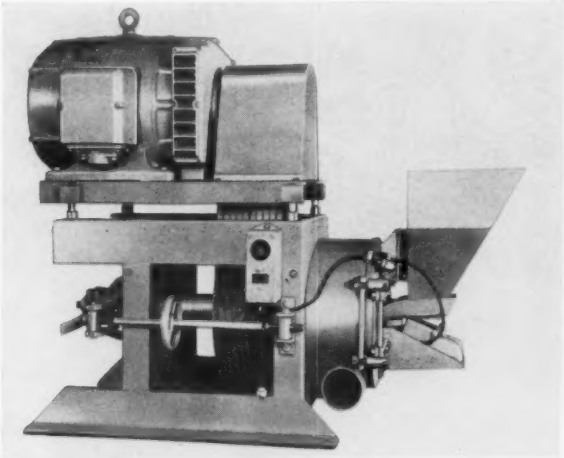
sure through limit controlled traversing roll mechanism and a three hp 1800 rpm 220 or 440 volt, three phase 60 cycle Reuland magnetic brake motor. The clam shell action of the dies is controlled by an automatic sequence apparatus and a one-half hp 1800 rpm Reuland brake motor. Knock-out assemblies are operated by 40 to 80 psi filtered air.

Water-Cooled Attrition Mill

► A new design has been developed by Foremost Machine Builders, Inc., Livingston, N. J., which now offers a water-cooled attrition mill for reduction of cured rubber scrap to replace its old span grinder. Efficiency is said to be excellent, with the new machine producing



20 mesh material and below at approximately double the rate of previous equipment using the same horsepower. Ordinary cured rubber in 5/16-inch particles is processed at a rate of 600 to 900 pounds per hour. A complete system is obtainable through the Foremost representative, Rainville Co., Inc., 224 Seventh St., Garden City, N. Y. This system is said to produce 350 pounds per hour of material 30 mesh and below utilizing a 75 hp motor.

Surface Pyrometer

► Pyrometer Service Co., Inc., 348 River Road, North Arlington, N. J., manufactures a surface pyrometer designed to measure temperatures up to 1500°F. on flat or curved surfaces, platens, injection molding heads, plastic molding dies and similar objects. Designated Model 1331, the pyrometer has a swivel head which permits the operator to measure temperatures at any angle or deflection and still keep the dial of the instrument visible at all times. The pyrometer can be converted to the cable type by inserting a special cable between the instrument and the rigid pick-up arm.

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Further details are easily obtained by writing to:

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Reviews

BOOKS

Reinforcement in Rubbers. By D. Parkinson. Published by the Institution of the Rubber Industry, 4 Kensington Palace Gardens, London W.8, England. 6 x 8 in. 102 pp. $4.00.

(Available From Book Department, RUBBER AGE)

This book is the fourth in a series of monographs by leading authorities published in the Institution's series of monographs designed to provide concise yet full information on subjects of key importance to the industry. The author brings to the publication the authority of a lifetime spent in practical compounding and in research.

The completeness of coverage is indicated by the chapter titles: (1) Introduction and Historical; (2) Properties of Carbon Blacks; (3) Influence of Carbon Blacks on the Properties of Unvulcanized Rubber; (4) Factors Influencing Reinforcement; (5) Influence of Carbon Blacks on the Properties of Vulcanized Rubbers; (6) Effect of Some Non-Black Fillers on the Properties of Natural Rubber; (7) Bound Rubber or Rubber-Carbon Gel; (8) Distribution and Dispersion of Carbon Black Particles in Rubber; (9) Some Effects of Carbon Structure; (10) The Influence of Milling Procedure and Subsequent Treatment on Physical Properties; (11) Theories of Stiffening.

(12) Softening of Rubber-Filler Vulcanizates by Applied Stress; (13) Rubber-Filler Linkages; (14) Secondary Linkages G_r; (15) Primary Linkages G^*; (16) Particle Size, Surface Area and Linkage Formation; (17) Effects in Rubber of Surface Porosity of Carbon Black; (18) Surface Treatment of Carbon Blacks and its Effect on Rubber Properties; (19) Chemical Considerations; (20) Further Effects of Fillers; (21) Thermodynamics and Reinforcement; (22) Possible Mechanisms of Reinforcement.

The author, who is a Colwyn Medallist, has made a far-reaching survey of the literature, and all who deal with this subject will find the extensive bibliography—arranged by alphabetization of authors' names—of great value. A subject index concludes the volume.

•

Dangerous Properties of Industrial Materials. By N. Irving Sax. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 6¾ x 10 in. 1468 pp. $22.50.

This large book is a completely revised and enlarged edition of "Handbook of Dangerous Materials." Over 8,500 materials are listed in alphabetical order, with descriptions, formulas, ratings as to toxicity, and reference to fire hazard, personal hygiene, storage and handling problems. Specific instructions are given for dealing with each. Five other experts in their fields have assisted the author by preparing special text sections on such subjects as toxicology, ventilation control, personnel protection and personal hygiene, atmospheric pollution, radiation hazards, industrial fire protection and others. Two closing sections are devoted to shipping regulations and synonyms of chemical names. The volume is a useful compilation of safety information.

•

Hi-Lo Chemical Prices: 1958. Published by "Oil, Paint and Drug Reporter," 30 Church St., New York 7, N. Y. 7 x 9 in. 340 pp.

This is a six-year study of the price behavior of the basic quantities of chemicals and related process materials, compiled by years from the weekly quotations appearing in *Oil, Paint and Drug Reporter*. The materials are listed in alphabetical order, with high and low prices for the years from 1952 to 1957. The quotations reflect a variation in price for that part of the market where the bulk of the business is done. The list of materials is extensive, and the information as to trends in prices over the last half-decade readily accessible to those who deal in the chemical market.

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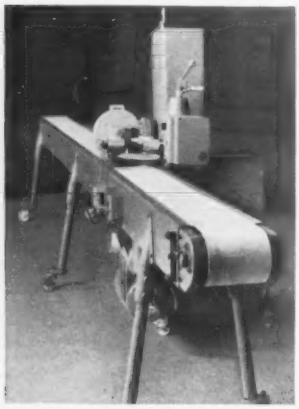

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REVIEWS (CONT'D)

BOOKLETS, CATALOGS, etc.

SP Rubber. By W. P. Fletcher and H. C. Baker. (Technical Bulletin No. 2). The Natural Rubber Development Board, Market Buildings, Mark Lane, London, E. C. 3, England. 6 x 9 in. 20 pp.

Superior processing natural rubber, generally referred to as SP Rubber, a new type of rubber developed in the laboratories and experiment station of the Rubber Research Institute of Malaya, is described in this bulletin. Designed to overcome problems in the processing of compounds, with advantages most striking in extruded and calendered products, SP Rubber is described in detail and uses are given. Mixing, milling and curing data are included. The physical properties of two types of vulcanizates—one based on a white extrusion compound and the other on a truck tire tread compound—are presented. A list of sources concludes the booklet.

•

Carbowax Polyethylene Glycols. Union Carbide Chemicals Co., 30 East 42nd St., New York 17, N. Y. 8½ x 11 in. 54 pp.

Properties, applications, storage, specifications and testing of Carbowax polyethylene glycols are analyzed in this booklet. In addition to expanding and bringing up to date previously published information on these compounds, new data for potential users on physiological properties, viscosities of blends, and Cabrowax Polyethylene Glycol 20-M are given. Applications in the rubber industry which are described are mold lubricants, foam rubber, tire air-bag lubricants, latex lubricants, and miscellaneous uses including neoprene rubber compounding for uniform hardness. A section on specifications and test methods completes the booklet.

•

Summit Hydrous Alumina Silicates. (Bulletin No. 1257). Summit Mining Corp., Carlisle, Penna. 8½ x 11 in. 8 pp.

The Summit line of hydrous alumina silicates, used as fillers in a variety of industrial applications, is described in this bulletin. Chemical and physical properties, compatibilities, dehydration reactions and particle size distribution are detailed. Applications are specified on a comprehensive chart. Two of the materials, Microcite and Ser-X, are recommended for use in rubber compounding.

•

Industrial Dust Control. (Bulletin No. 104). W. W. Sly Manufacturing Co., Cleveland 1, Ohio. 8½ x 11 in. 36 pp.

The complete line of dust filters produced by Sly Manufacturing Co. is described in this comprehensive booklet. Contents include a description of operating principles, and information is given on capacities and dimensions, and continuous and non-continuous applications. Engineering drawings are provided to assist in designing dust control systems. Tables aid in determining components to meet particular job requirements.

•

Reliance VSMR Mill Regulator. (Bulletin No. K-2503). Reliance Electric and Engineering Co., 24701 Euclid Avenue, Cleveland 17, Ohio. 8½ x 11 in. 6 pp.

A new electronic regulator unit designed to provide precise regulation of line speed, voltage and tension for all continuous-process industries is described in this publication. Copy, photos and drawings explain the features of the unit, and describe its advantages.

Gaps in your library? Contact Book Dept., Rubber Age, 101 West 31st St., New York 1, N. Y.

Influence of Petroleum Oils on Staining and Discoloration of Elastomeric Compounds. (G. B. Report No. 10). Golden Bear Oil Co., P. O. Box 446, Oildale, Calif. 6¼ x 9¼ in. 26 pp.

The findings reported in this booklet are the result of a co-operative study between the Gates Rubber Co. and Golden Bear Oil Co. The two principal objectives were (1) selection of suitable instruments and test methods giving color readings of general validity and permanent meaning, and (2) establishing the influence of oil composition on color phenomena of elastomeric compounds containing the oils. The data reported can serve as a first orientation on how to select petroleum oils suitable as plasticizers and extenders for non-discoloring and non-staining elastomeric compounds. The booklet is a reprint of the article which appeared in the August, 1957 issue of *Industrial and Engineering Chemistry*, to which has been added a table of contents, a foreword and an appendix listing the physical properties of the compounds tested.

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Indulin. (Technical Bulletin No. 100). Polychemicals Division, West Virginia Pulp and Paper Co., Charleston A, S. C. 8½ x 11 in. 20 pp.

Indulin, an alkali lignin derived from wood which finds application as a surfactant, extender, dispersant, reinforcement agent binder, sequestering agent, emulsifier, emulsion stabilizer and protective colloid, is described in this booklet. Among the many commercial uses listed are as a reinforcing agent for styrene, natural, neoprene and nitrile rubbers, and as an additive for rubber latex to give stronger, harder and tougher films. Tables and charts are used to show properties in aqueous systems and in solvent systems.

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V-Belts—The Testing, Inspection and Control of Their Quality. (Booklet No. S-51107). Goodyear Tire & Rubber Co., Akron 16, Ohio. 5 x 7 in. 16 pp.

Fourth in a series, this new booklet describes in text and pictures how a V-belt is processed to insure top quality. Discussed are testing of raw materials and rubber compounds, test equipment, power for testing machines, a dynamometer test laboratory, experimental production, x-ray inspection, coding and matching for belt length, electronic and test equipment inspection and quality control. Enough space is given to text to explain the subject thoroughly and the photographs are both numerous and pertinent.

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Sharples Brand Ethylac as a Delayed Action Activator. (Bulletin S-130). Industrial Division, Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Penna. 8½ x 11 in. 4 pp.

Use of Ethylac (2-Benzothiazyl-N, N-diethylthiocarbamyl Sulfide) as a delayed action activator for thiazole-type accelerators is treated in this brochure. Results of test with a base compound varied by using different parts MBT, MBTS, NOBS, Santocure, Santocure NS or DIPAC with various additions of Ethylac are given. Comparisons of the effects on physical properties produced by different cure times for each are also made in tabular form.

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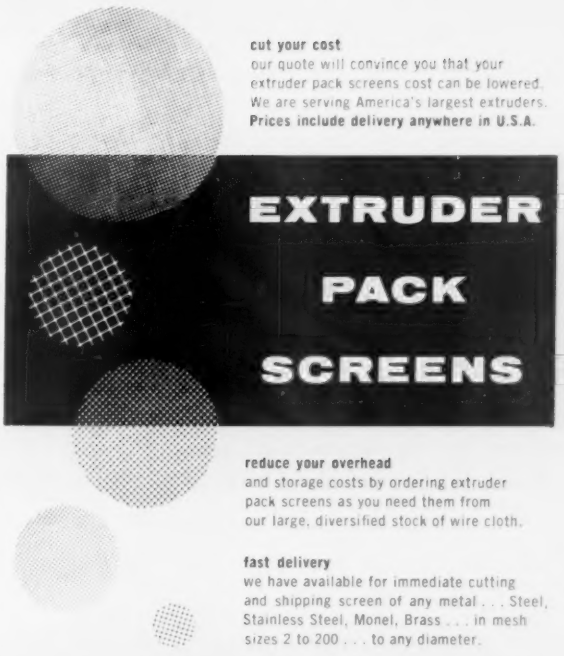
Buflovak Processing Equipment. (Catalog No. 380). Buflovak Equipment Division, Blaw-Knox Co., 1575 Fillmore Ave., Buffalo, N. Y. 8¼ x 11 in. 24 pp.

This bulletin gives descriptions and specifications of the company's equipment such as autoclaves; quick-opening autoclave doors; processing kettles; evaporators; drum, rotary, pan and vacuum dryers; and other machines, as well as pilot plant and laboratory equipment. Numerous photographs illustrate the equipment and its installation. Many in the research, testing and manufacturing sides of the industry will find this booklet of interest and value.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MARKET REPORTS

TRENDS
NEWS
PRICES

Natural Rubber

Since our last report (February 3), the price of spot rubber on the New York Commodity Exchange has moved in the rather narrow range of 87 points, high for the period being 26.75c reached on February 26, and low being 25.88c reached on February 10. The average price of spot rubber for the month of February was 26.32c based on 19 trading days. This compares with an average of 27.15c in the previous month.

The trade reports that natural rubber producers are currently caught between the devil and the deep blue sea. The devil: competition from synthetic rubber. The deep blue sea: lower world prices for natural rubber. The main factors depressing prices have been lower automobile output and lagging tire demand.

Natural Price Levels

Natural rubber now fetches about 26c a pound in New York and this is roughly 3½c below the mid-December peak caused by the political crisis in Indonesia. At the present level, natural rubber is only a few cents above the price for synthetic rubber. This could be a vital advantage.

The use of synthetic rubber has grown very sharply during recent periods when natural rubber (which has been as high as 48c a pound in the last two years) has been bringing a substantial premium. Lower demand, however, promises to go on holding down natural prices. Some manufacturers in the United States have already scaled down optimistic forecasts of their 1958 volume.

With synthetic rubber gradually eroding the natural rubber market in the U.S., natural producers would seem to have cause for concern. Some observers see much the same situation developing in Europe, and this too worries the natural rubber producer.

According to the Natural Rubber Bureau, natural rubber consumption in the U. S. in 1957 dropped about 23,000 long tons to 539,000 long tons. Consumption of synthetic rubber, on the other hand, increased by more than 50,000 long tons to approximately 930,000 long tons.

Natural's Share Declines

As a consequence, the share of the over-all market held by natural rubber declined to 36.7 per cent from 39.1 per cent in 1956. While lower natural rubber prices may strengthen its competitive position, these lower prices are bound to create difficulties by affecting the export earnings of primary producers such as Indonesia and Malaya. The most significant sign, however, is that at the moment there is no discernible swing to natural.

If the price of natural rubber remains at about the current level, the general opinion is that some shift to natural will occur. The major consideration at the moment however, is general business activity in the U.S. and in Europe. For the time being, the market will likely pursue an erratic course.

According to the Rubber Manufacturers Association, 46,349 long tons of natural rubber were imported into the U.S. in January, 1958. In the same month, 52,631 long tons were consumed.

NEW YORK, MARCH 3, 1958

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM FEBRUARY 1 TO FEBRUARY 28

Feb.	Spot	Mar.	May	July	Sept.	Sales
1	....	....	....	....	....	...
2	....	....	....	....	....	...
3	26.63	26.60	27.05	27.25	27.30	35
4	26.25	26.20	26.60	26.86	26.90	77
5	26.50	26.65	26.85	27.05	27.05	62
6	26.25	26.25	26.60	26.80	26.85	63
7	26.25	26.25	26.65	26.90	26.90	42
8	....	....	....	....	....	...
9	....	....	....	....	....	...
10	25.88	25.85	26.25	26.50	26.55	80
11	26.25	26.25	26.50	26.80	26.90	68
12	....	....	....	....	....	...
13	25.88	25.75	26.06	26.40	26.45	57
14	26.00	26.00	26.29	26.55	26.65	43
15	....	....	....	....	....	...
16	....	....	....	....	....	...
17	26.13	26.15	26.45	26.73	26.77	24
18	26.63	26.55	26.95	27.25	27.35	119
19	26.25	26.30	26.65	26.90	27.05	14
20	26.13	26.05	26.40	26.65	26.75	80
21	26.38	26.30	26.70	26.90	26.95	120
22	....	....	....	....	....	...
23	....	....	....	....	....	...
24	26.50	26.60	26.80	27.05	27.10	41
25	26.50	26.47	26.85	27.00	27.00	58
26	26.75	26.66	27.00	27.15	27.20	108
27	26.50	26.40	26.75	26.85	26.86	69
28	26.50	26.40	26.60	26.60	26.63	62

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.25⅞
Apr.	.26
May	.26⅛
Thin Latex Crepe:	
Spot	.28
Thin Brown Crepe, No. 2	.23¼
Flat Bark Crepe	.20

London Market
(Standard Smoked Sheets)

Apr.-June	26.40 - 26.54
July-Sept.	26.54 - 26.69

Singapore Market
(Standard Smoked Sheets)

Apr.	25.24 - 25.28

Middling Upland Quotations

	Feb. 3	Mar. 3		
	Close	High	Low	Close
Mar.	35.05	35.38	35.18	35.35
May	35.10	35.58	35.45	35.58
July	35.08	35.82	35.72	35.81

Notes & Quotes

According to Maurice Symington, chairman of the Rubber Trade Association of London, the demand for increasing quantities of natural rubber from Communist countries and from Japan continues and appears to have offset the increased use of synthetic rubber in countries outside the United States. Mr. Symington is of the opinion that consumption of all types of rubber in 1958 will increase by some 100,000 long tons to 3,250,000 long tons. The present situation in Indonesia suggests that supplies of natural rubber from that country may decline. This means that additional demands will have to be met by synthetic rubber and that all the natural rubber which will be produced will be consumed.

Synthetic Rubber

According to figures made available by the Rubber Manufacturers Association, 102,663 long tons of synthetic rubber of all types were produced in the United States in January, 1958, against the 103,779 long tons produced in the preceding month. A total of 71,386 long tons of synthetic rubber were consumed during January, against the 67,509 long tons consumed in December, 1957. The share of the over-all market held by synthetic rubber in January amounted to 63.03 per cent contrasted with 63.95 per cent in the previous month.

On the face of it, synthetic rubber continues in the production-consumption pattern set during the past year. Its share of the market has decreased slightly, but its over-all consumption has increased slightly. There have been no noticeable shifts. The year is young, however, and the statistics for the next few months may be a bit more revealing of trends.

General Position Good

Whatever can be said for synthetic rubber and the situation in which it finds itself, must surely revolve on its favorable market position. Increased activity in synthetic rubber is reported from many parts of the world. The new Italian petrochemical plant at Ravenna has already gone into operation. Scheduled to be completed shortly, this plant will make Italy the largest producer of general purpose synthetic rubber in Europe.

According to Merrill Lynch, Pierce, Fenner & Beane, the new plant will have an annual production of 65,000 to 70,000 long tons of styrene rubber. The plant is so constructed that production can be expanded if the situation warrants.

Italy is said to consume about 25,000 long tons of synthetic rubber a year. Thus, an exportable surplus of some 40,000 tons will be established when the Ravenna plant is in full production. This is equal to about 20 per cent of the exports made by the United States in 1957.

The Ravenna plant's production is not expected to cut into U.S. exports as the general trend to synthetic consumption in Europe is on the increase. As a matter of fact, there will not be sufficient synthetic capacity in Europe for some years and the gap between production and consumption will have to be met by exports from the United States and Canada.

Natural-Like Synthetic

Still another report favorable to the synthetic rubber picture comes from the U.S. Army Quartermaster Research and Development Command which recently was reported to have declared that the new natural-like synthetic rubbers may make it possible to reduce stockpiling of natural rubber at a great saving of money and space.

One major producer of natural-like synthetic estimates that in full production the price of this type of synthetic rubber would be about the same as natural rubber. The Army, for its part, reported that the development of these natural-synthetic rubbers leaves the country completely independent of outside sources of natural rubber in the event of an emergency.

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Polyglycol 11-100 • *Polyglycol 11-200* • *Polyglycol 11-300*
Polyglycol 11-400 • *Polyglycol 112-3*

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Dry Rubber

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene NAA	.5400 [1]
Butaprene NF	.4900 [1]
Butaprene NL	.5000 [1]
Butaprene NXM	.5800 [1]
Chemigum N1	.6400 [2]
Chemigum N3 and N5	.5800 [2]
Chemigum N6 and N7	.5000 [2]
Herecol N-33	.6800 [2]
Hycar 1001	.5800 [2]
Hycar 1002	.5000 [2]
Hycar 1014	.6000 [2]
Hycar 1041	.5800 [2]
Hycar 1042 and 1043	.5000 [2]
Hycar 1312	.5000 [4]
Hycar 1411	.6200 [2]
Hycar 1432	.5900 [4]
Hycar 1441	.6200 [2]
Paracril AJ	.4850 [2]
Paracril B	.5000 [2]
Paracril BJ	.5000 [2]
Paracril BLT	.5000 [2]
Paracril C	.5800 [2]
Paracril CV	.5900 [2]
Paracril D	.6500 [2]
Paracril 18-80	.6000 [2]
Polysar Krynac 800	.5000 [2]
Polysar Krynac 801	.5800 [2]
Polysar Krynac 802	.5000 [2]
Polysar Krynac 803	.5000 [2]

Butadiene-Styrene Types

Ameripol 1000	.2410 [2]
Ameripol 1001	.2410 [2]
Ameripol 1002	.2435 [2]
Ameripol 1006	.2410 [2]
Ameripol 1007	.2425 [2]
Ameripol 1009	.2475 [2]
Ameripol 1500	.2410 [2]
Ameripol 1501	.2410 [2]
Ameripol 1502	.2410 [2]
Ameripol 1703	.2060 [2]
Ameripol 1705	.2035 [2]
Ameripol 1707	.1910 [2]
Ameripol 1708	.1910 [2]
Ameripol 1710	.1885 [2]
Ameripol 1712	.1885 [2]
ASRC 1000	.2410 [2]
ASRC 1001	.2410 [2]
ASRC 1004	.2410 [2]
ASRC 1006	.2410 [2]
ASRC 1009	.2475 [2]
ASRC 1018	.2700 [2]
ASRC 1019	.2650 [2]
ASRC 1500	.2410 [2]
ASRC 1502	.2410 [2]
ASRC 1503	.2625 [2]
ASRC 1703	.2060 [2]
ASRC 1708	.1910 [2]
ASCR 3110	.2600 [2]
Baytown 1600	.1760 [2]
Baytown 1601	.1760 [2]
Baytown 1602	.1760 [2]
Baytown 1801	.1600 [2]
Copo 1500	.2410 [2]
Copo 1502	.2410 [2]
Copo 1505	.2610 [2]
Copo 1712	.1885 [2]
FR-S 1000	.2410 [2]
FR-S 1001	.2410 [2]
FR-S 1004	.2410 [2]
FR-S 1006	.2410 [2]
FR-S 1009	.2475 [2]
FR-S 1010	.2600 [2]
FR-S 1012	.2425 [2]
FR-S 1013	.2500 [2]
FR-S 1014	.2810 [2]
FR-S 1015	.2910 [2]
FR-S 1500	.2410 [2]
FR-S 1502	.2410 [2]
FR-S 1703	.2060 [2]
FR-S 1705	.2035 [2]
FR-S 1712	.1885 [2]
Naugapol 1016	.2650 [2]
Naugapol 1018	.2700 [2]
Naugapol 1019	.2650 [2]
Naugapol 1021	.3000 [2]
Naugapol 1022	.2800 [2]
Naugapol 1023	.2850 [2]
Naugapol 1503	.2625 [2]
Naugapol 1504	.2950 [2]
Philprene 1000	.2410 [1]
Philprene 1001	.2410 [1]
Philprene 1006	.2410 [1]
Philprene 1009	.2475 [1]
Philprene 1010	.2600 [1]
Philprene 1018	.2700 [1]
Philprene 1019	.2650 [1]
Philprene 1100	.1940 [1]
Philprene 1104	.1900 [1]
Philprene 1500	.2410 [1]
Philprene 1502	.2410 [1]
Philprene 1503	.2625 [1]
Philprene 1600	.1930 [1]
Philprene 1601	.1930 [1]
Philprene 1605	.1900 [1]
Philprene 1703	.2060 [1]
Philprene 1706	.2030 [1]
Philprene 1708	.1910 [1]
Philprene 1712	.1885 [1]
Philprene 1803	.1740 [1]
Plioflex 1006	.2410 [2]
Plioflex 1500	.2410 [2]
Plioflex 1502	.2410 [2]
Plioflex 1703	.2060 [2]
Plioflex 1710	.1885 [2]
Plioflex 1712	.1885 [2]
Plioflex 1773	.2060 [2]
Plioflex 1778	.1910 [2]
Polysar Kryflex 200	.2510 [2]
Polysar Krylene	.2410 [2]
Polysar Krylene NS	.2410 [2]
Polysar Krynol 651	.1885 [2]
Polysar Krynol 652	.1910 [2]
Polysar S	.2410 [2]
Polysar S-50	.2410 [2]
Polysar S-X 371	.2550 [2]
Polysar SS-250	.2875 [2]
S-1000	.2300 [2]
S-1001	.2300 [2]
S-1002	.2325 [2]
S-1006	.2300 [2]
S-1011	.2325 [2]
S-1013	.2300 [2]
S-1100	.1850 [2]
S-1500	.2300 [2]
S-1502	.2300 [2]
S-1600	.1825 [2]
S-1601	.1825 [2]
S-1602	.1825 [2]
S-1703	.1950 [2]
S-1706	.1925 [2]
S-1707	.1800 [2]
S-1709	.1775 [2]
S-1712	.1775 [2]
S-1801	.1675 [2]
S-1803	.1650 [2]
Synpol 1000	.2410 [1]
Synpol 1001	.2410 [1]
Synpol 1002	.2435 [1]
Synpol 1006	.2410 [1]
Synpol 1007	.2410 [1]
Synpol 1009	.2475 [1]
Synpol 1012	.2425 [1]
Synpol 1013	.2500 [1]
Synpol 1061	.2410 [1]
Synpol 1500	.2410 [1]
Synpol 1502	.2410 [1]
Synpol 1551	.2410 [1]
Synpol 1703	.2060 [1]
Synpol 1707	.1910 [1]
Synpol 1708	.1910 [1]
Synpol 1711	.1900 [1]
Synpol 1712	.1885 [1]

Butyl Rubbers

Enjay Butyl 035 and 150	.2300 [2]
Enjay Butyl 165 NS	.2400 [2]
Enjay Butyl 215	.2300 [2]
Enjay Butyl 217	.2300 [2]
Enjay Butyl 218	.2300 [2]
Enjay Butyl 268 NS	.2400 [2]
Enjay Buty 325	.2300 [2]
Enjay Butyl 365 NS	.2400 [2]
Polysar Butyl 100	.2450 [2]
Polysar Butyl 101	.2175 [2]
Polysar Butyl 200 and 300	.2450 [2]
Polysar Butyl 301	.2550 [2]
Polysar Butyl 400	.2450 [2]

Chlorosulfonated Polyethylene

Hypalon 20	.70 [2]

Neoprene

	(prices l.c.l.)
Neoprene Types AC and CG	.5500 [2]
Neoprene Type GN	.4100 [2]
Neoprene Type GN-A	.4100 [2]
Neoprene Type GRT	.4200 [2]
Neoprene Type KNR	.7500 [2]
Neoprene Type S	.4200 [2]
Neoprene Type W	.3900 [2]
Neoprene Type WHV	.3900 [2]
Neoprene Type WRT	.4500 [2]
Neoprene Type WX	.4100 [2]

Polysulfide Rubbers

	(prices l.c.l.)
Thiokol Type A	.4700 [2]
Thiokol Type FA	.6400 [2]
Thiokol PR-1	.9500 [2]
Thiokol Type ST	1.00 [2]

Silicone Rubbers*

	(prices l.c.l.)
GE (compounded)	2.50 [2]
GE Silicone Gum (not compounded)	4.00 [2]
Silastic (compounded)	1.90 [2]
Silastic (gums)	3.85 [2]
Union Carbide (gums)	4.00 [2]
Union Carbide (compounds)	2.50 [2]

Latex

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [1]
Butaprene N-400	.5400 [1]
Butaprene N-401	.5400 [1]
Chemigum 200	.4900 [2]
Chemigum 235	.5400 [2]
Chemigum 236	.5400 [2]
Chemigum 245	.4600 [2]
Chemigum 246	.4600 [2]
Hycar 1512	.4600 [2]
Hycar 1551	.5400 [2]
Hycar 1552	.4600 [2]
Hycar 1561	.5400 [2]
Hycar 1562	.4600 [2]
Hycar 1571	.5400 [2]
Hycar 1572	.5100 [2]
Hycar 1577	.4600 [2]
Hycar 1852	.4600 [2]
Nitrex 2612	.5000 [1]
Nitrex 2614	.5000 [1]
Nitrex 2614-A	.5000 [1]
Nitrex 2615	.5500 [1]
Nitrex 2615-A	.5500 [1]
Nitrex 2616	.5800 [1]
Nitrex 2617	.5000 [1]
Nitrex 2617-A	.5000 [1]
Nitrex 2619	.5700 [1]
Nitrex 2620	.5000 [1]
Nitrex 2625	.5000 [1]

Butadiene-Styrene Types

Copo 2101	.3000 [2]
Copo 2102	.3200 [2]
Copo 2105	.3200 [2]
Copo X-765	.3000 [2]
FR-S 2000	.2775 [2]
FR-S 2001	.2775 [2]
FR-S 2002	.3000 [2]
FR-S 2003	.3050 [2]
FR-S 2004	.3050 [2]
FR-S 2006	.2900 [2]
FR-S 2105	.3200 [2]
Pliolite 2000	.2775 [2]
Pliolite 2076	.2900 [2]
Pliolite 2101	.2775 [2]
Pliolite 2104	.3200 [2]
Pliolite 2105	.3200 [2]
Pliolite 2107	.3250 [2]
Pliolite 2108	.3050 [2]
Naugatex 2000	.3375 [1]
Naugatex 2001	.3375 [1]
Naugatex 2002	.3500 [1]
Naugatex 2006	.3900 [1]
Naugatex 2105	.3600 [1]
Naugatex 2107	.3600 [1]
Naugatex 2108	.3600 [1]

POLYMERS

S-2000	.2275 [3]
S-2006	.2150 [3]
S-2101	.2250 [3]
S-2105	.3100 [3]
S-2107	.3200 [3]

Neoprene

Neoprene Latex 60	.4000 [3]
Neoprene Latex 571	.3700 [3]
Neoprene Latex 572	.3900 [3]
Neoprene Latex 601-A	.4000 [3]
Neoprene Latex 735	.3800 [3]
Neoprene Latex 736	.3800 [3]
Neoprene Latex 842-A	.3700 [3]
Neoprene Latex 950	.4700 [3]

Polysulfide Rubbers

Thiokol Type MX	.7000 [3]
Thiokol Type WD-2	.9200 [3]
Thiokol Type WD-6	.7000 [3]

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

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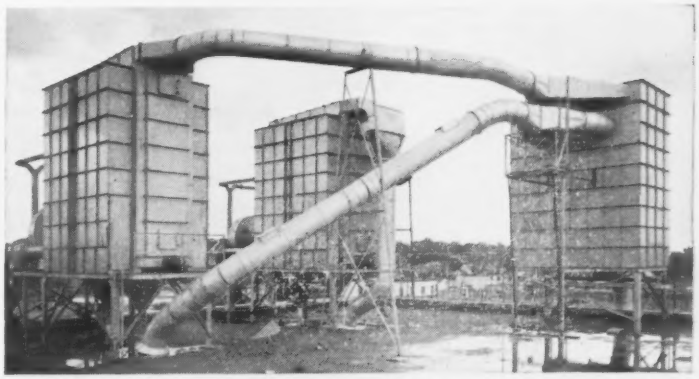
DAY

DUST CONTROL NEWS



Two DAY "AC" Dust Filters (left and center of photo) and DAY bag trap (at right) located on roof of rubber company plant. Empty carbon black bags are carried from work area to bag trap through same piping system used to control dust in work area. This eliminates bag disposal problems, speeds production.

Capture and Restore Carbon Black Dust Losses Automatically

DAY "AC"* Reverse Jet dust filters are favorites with rubber companies because they effectively control dust from Banbury mixers and return captured dust to the *same* mixture from which it escaped. This rapid return of dust means better control of weighed ingredients. It also eliminates adding extra materials to take care of "invisible" dust losses. This automatic and continuous return of ingredients improves mixture uniformity and batch quality.

The majority of DAY filters are installed *inside* rubber company plants. DAY filters are so highly efficient the clean air from the filter can be returned back to work areas. During the winter time this saves considerable heat loss. In summer the air from the filter can be exhausted outdoors to help keep the plant cooler. DAY dust control improves product quality and helps increase production for rubber companies. It is your best dust control buy. **For the latest information about DAY services and "AC" dust filters write toDAY for your copy of Bulletin F-75.**

*Licensed by H. J. Hersey, Jr.

The **DAY** *Company*

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The DAY SALES Company
803 Third Ave. N.E., Minneapolis 13, Minn.

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EQUIPMENT ONLY OR A COMPLETE SYSTEM

MARKETS

(continued)

Reclaimed Rubber

The production rate for reclaimed rubber seems to have received no stimulus with the coming of the new year according to the Rubber Manufacturers Association which reports that 20,600 long tons of reclaim were produced in January, 1958. In the preceding month, 20,050 long tons were produced while in January of 1957, 25,053 long tons were turned out.

Naturally enough, the reclaimed rubber market is caught up in the same set of conditions which trouble the general economy. Automobile production is off and this one factor alone does much to dictate the terms under which the reclaimed rubber market operates. Falling prices for natural rubber also tend to confuse the atmosphere where reclaim is concerned.

It is generally expected that some 240,000 long tons of reclaimed rubber will be produced and consumed in 1958. This will represent a drop from the comparable 1957 figures, but they should adequately represent the market picture as it looks today.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11½
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09¾
Black Carcass	.15¼
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

There were few encouraging developments in the scrap rubber market during the past few weeks. RMA reports that some 19,000 long tons of scrap rubber were consumed in January. One major reclaimer reopened after shutting down for a week but was accepting only tubes, chiefly butyl.

Scrap rubber exports rose sharply in the latter part of 1957 according to the U.S. Department of Commerce. October shipments abroad came to 5,087,873 pounds valued at $174,322, as against 2,091,755 pounds worth $140,353 in the previous month.

So far in 1958, the scrap rubber market is showing the steadiness at the low level which characterized the market in 1957. There does not appear to be anything in the offing which will contribute to any startling uptrend or downtrend in the near future. Accordingly, prices remain at the same levels evidenced during the past few months and are expected to remain at these levels.

(Prices Delivered Akron)

Mixed tires	ton	15.50
Light colored carcass	lb.	.05
No. 1 peelings	ton	30.00
No. 2 peelings	ton	25.00
No. 3 peelings	ton	18.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	19.00
Passenger S.A.G.	ton	17.50
Natural Rubber Red Tubes	lb.	.07½
Natural Rubber Black Tubes	lb.	.07¾
Butyl Rubber Tubes	lb.	.04⅜

Tire Fabrics

According to the trade, an easier tone has developed in wide industrial fabrics with transactions taking place in some of these goods at "shaded" prices. Price shading is not universal in this market since some mills apparently are continuing to hold at the same quotations which they have maintained for a number of weeks.

Price concessions are also not easy to obtain on small orders for immediate shipment. Where a sizable yardage is involved, however, certain mills appear ready to trade off. Some sales have taken place in the 59-inch, 2.25 yard drill at 28c in a number of cases, with less desirable makes selling even lower.

The 59-inch, 1.85 yard drill, which has been quoted at 33½c nominally for some time is reported to have sold in some instances at around 32½ to 33c a yard. In wide sheetings, similar price concessions can be obtained from some sources of supply. In wide sateens, on the other hand, a slightly steadier tone is evident, with a supply squeeze continuing on seconds and shorts in these goods as a result of the drastic mill cutbacks in production.

Rayon-Nylon Battle

The "battle" between rayon and nylon for the tire cord market continues with every indication that the intensity of the struggle will reach new peaks in 1958. The rayon producers claim that they now hold about 99 per cent of the passenger car tire cord market, while nylon has been making greatest inroads into the off-the-road tire field and in airplane tires.

According to announcements by nylon cord producers, principally Chemstrand, a new push will soon be made to recapture the passenger car tire market for nylon. In its past history, nylon has been handicapped in its competitive struggles with rayon by the price factor. In these days of tightened belts, this price matter may prove a major obstacle.

From a technical point of view, each of the two cords has much to offer. It is difficult, however, to relate technical matters to a lay audience. A recent survey, for example, pointed out that 35 per cent of some 2,000 car drivers questioned did not know what tire cord was. Only 42 per cent considered tire cord important in the purchase of a tire.

At any rate, what is happening is that the competitive battles between the cords are bringing better and better cords before the public at an accelerated pace. The next few months should have great significance in the continuing struggle.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.73
1650	lb.	.67
2200	lb.	.67½

Nylon Tire Cord

210	lb.	1.95
840	lb.	1.80

Rayon Graded Fabric

1100	lb.	.69
1650	lb.	.63½
2200	lb.	.63

Cotton Chafers

8.9 oz. (per square yard)	lb.	.68
9.25 oz. (per square yard)	lb.	.66
11.65 oz. (per square yard)	lb.	.62
14.4 oz. (per square yard)	lb.	.71

Liquid Latex

Natural: A total of 4,833 long tons of natural rubber latex were imported into the United States in January, thus ushering in the new year rather inauspiciously. In all of 1957, average monthly imports totaled 5,250 long tons. A grand total of 63,017 long tons of natural rubber latex were imported into the United States in 1957.

In December, 1957, a total of 6,006 long tons of natural rubber latex were consumed in the United States. In January, 1958, 6,018 long tons were consumed according to the Rubber Manufacturers Association. As of January 31, 1958, there were 13,662 long tons of natural latex on hand. At the end of the previous month, there were 14,299 long tons of latex on hand.

Natural rubber latex is currently selling at about 34c a pound at East Coast ports in car load quantities. It is thought by many in the trade that these price levels make natural more attractive to the potential consumer and that statistics for the next few months will reflect this fact.

Synthetic: Production of S-type latex in 1957 at 74,405 long tons set an all-time record in the United States as did the 67,239 long tons consumed. The synthetic latex production and consumption figures have been showing a steadily rising pattern over the years acting almost independently of other sections of the market.

What with the increasing uses for latex, it may well be expected that no matter what happens to dry rubber in 1958, the latex market, and particularly the synthetic latex market, will continue to show an increasing production-consumption pattern.

Cotton

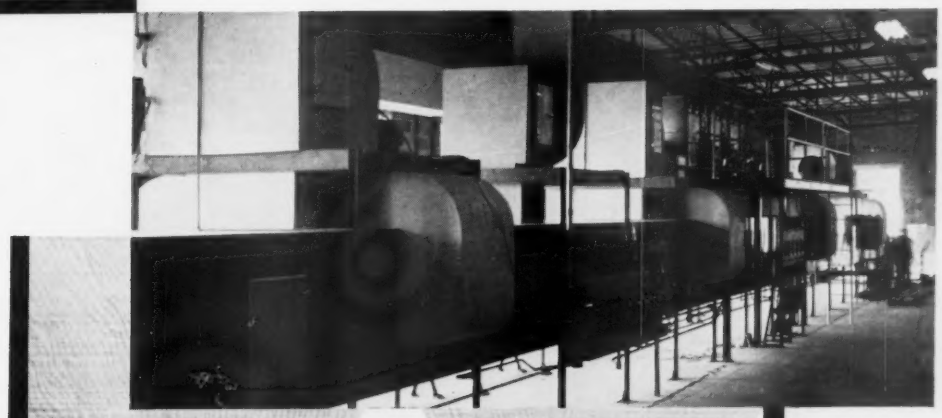
The price of middling uplands on the New York Cotton Exchange has moved in the range of 145 points since our last report (February 3), high for the period being 36.15c reached on February 3 and on two other days during the month, and low being 34.70c reached on February 10. The average price of middling uplands for the month of February was 35.83c based on 19 trading days. This compares with an average of 36.31c in the previous month.

The trade reports that the chances of getting legislation to increase cotton acreage allotments are growing dimmer and there is practically no chance of getting Congress to approve a program calling for lower price supports. The Administration is opposed to any increase in acreage allotments, and if Congress approves more funds for the soil bank, it is likely that more than 3,500,000 acres may be signed up for cotton crop land during this season.

The continuation of a high support price of 34.60c basis middling inch, and the possibility of a revision in the loan level upward, is expected to stagnate the demand for domestic mill use to a "hand to mouth" basis. Should the crop, however, get off to an unfavorable start, a short crop could force prices above the loan level to provide a hedge basis for some merchants. Of course, much of this will hinge upon whether or not parity prices rise between January and July.

ROSS
Air Systems

Engineered Atmospheres for Better Processing



WAVINESS replaced by UNIFORMITY

LATEX SATURATED FABRIC shrinkage control... the major problem!

In this special application of an 'Engineered Atmosphere' the key step was not so much to control temperature, hence the drying, but rather to control shrinking. Shrinkage, because of the nature of the material, was unavoidable. The problem was to get the web to shrink uniformly across the width. This in turn called for the proper introduction, direction and circulation of the hot air stream at the right temperature. The project is working very effectively. Uneven shrinkage has been eliminated. Maximum utilization of the web by the processor is assured.

This is the kind of work that is well within the scope of Ross Engineering Service. It definitely involves the creation and maintenance of an 'Engineered Atmosphere' as do practically all drying, curing, baking, treating and similar treating and processing problems. Ross Engineers have been serving industry in this way for more than thirty-five years.

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STATISTICS of the industry

PERTINENT INDUSTRY DATA

Natural Rubber in the United States

(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1931	501,788	355,200	25,609	322,000
1932	414,668	336,700	20,937	379,000
1933	418,902	412,400	20,576	365,000
1934	463,018	462,500	23,856	355,000
1935	467,146	495,500	11,391	303,000
1936	488,145	575,000	12,582	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,113	9,665	93,650
1945	135,672	105,429	6,743	118,715
1946	400,687	277,597	4,338	237,467
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1949	660,792	574,522	6,253	106,619
1950	802,249	720,268	8,644	89,215
1951	733,048	454,015	2,603	76,569
1952	805,997	453,846	3,024	95,260
1953	647,150	553,473	8,376	112,316
1954	596,848	596,285	7,443	104,543
1955	635,174	634,800	10,611	110,105
1956	580,510	563,095	11,300	115,949
1956:				
Dec.	57,653	45,227	912	115,949
1957:				
Jan.	46,349	52,631	691	101,758
Feb.	37,487	46,427	693	100,253
Mar.	40,680	48,263	1,218	97,820
Apr.	59,896	45,368	530	102,796
May	52,566	46,385	738	98,817
June	30,290	41,282	859	90,694
July	44,760	39,789	483	98,871
Aug.	48,951	44,933	1,000	99,093
Sept.	44,188	43,675	780	103,233
Oct.	49,371	48,782	926	102,496
Nov.	44,583	43,696	1,225	97,754
Dec.	44,544	38,058	1,000	100,473

Source: U. S. Department of Commerce.

U. S. Imports of Natural Rubber

Year	Dry Long Tons	Dry Declared Value	Latex Long Tons	Latex Declared Value	Total Imports
1936	467,064	152,072,496	19,852	6,659,899	486,916
1937	574,600	237,307,041	23,185	10,213,670	597,785
1938	397,640	125,373,864	11,944	4,168,127	409,584
1939	469,946	167,586,780	27,437	10,467,552	497,383
1940	781,202	303,308,823	33,789	14,593,466	814,991
1941	989,498	401,976,317	34,797	15,965,627	1,024,245
1942	266,276	112,537,426	10,646	5,630,667	276,922
1943	50,358	31,369,198	1,890	1,312,202	52,248
1944	103,847	73,908,549	3,091	2,092,211	106,938
1945	134,408	95,814,102	4,773	3,115,853	139,181
1946	376,502	228,796,110	8,421	5,843,085	384,923
1947	691,087	306,951,814	17,542	9,787,722	708,629
1948	702,293	290,849,177	32,745	18,288,223	735,038
1949	630,808	225,343,624	29,743	14,968,650	660,551
1950	747,109	416,222,598	54,401	41,764,486	801,510
1951	677,874	727,343,348	54,963	80,178,309	732,837
1952	756,987	578,179,519	48,228	40,563,116	805,215
1953	571,635	284,909,223	75,511	46,353,333	647,146
1954	522,364	219,098,143	74,483	42,755,029	596,847
1955	542,507	360,435,303	92,825	80,163,114	635,332
1956	499,479	334,990,045	71,709	61,795,844	564,321
1956:					
Nov.	44,995	26,695,282	4,761	3,698,504	49,756
Dec.	50,992	31,077,000	6,661	5,170,306	57,653
1957:					
Jan.	39,889	24,412,461	6,461	5,203,207	46,350
Feb.	33,145	21,603,218	4,342	3,491,712	37,487
Mar.	34,824	22,769,949	7,336	5,193,356	42,160
Apr.	51,084	31,631,505	8,812	6,608,083	59,896
May	46,772	26,960,166	5,794	4,309,057	52,566
June	25,481	15,262,392	4,810	3,605,798	30,291
July	38,517	23,567,902	6,243	4,721,139	44,760
Aug.	42,117	25,931,151	6,834	4,900,028	48,951
Sept.	38,672	24,073,879	5,516	4,266,918	44,188
Oct.	41,020	25,996,607	8,351	6,120,335	49,020
Nov.	38,087	22,885,060	6,496	4,688,156	44,583

Source: Bureau of the Census, U. S. Department of Commerce.

World Production of Natural Rubber

(Including Latex)

(Long Tons)

Year	Malaya	Indonesia	Ceylon	Viet Nam & Cambodia	Latin America	Rest of World*	Total*
1945	8,600*	10,000*	97,500	12,000*	47,125	73,570	250,000
1946	403,719	175,000*	94,000	19,975	39,678*	105,080	837,500
1947	646,362	277,951	89,000	38,128	34,928*	172,782	1,260,000
1948	698,189	432,349	95,000	43,935	29,158*	225,557	1,525,000
1949	671,503	432,996	89,500	43,010	27,318*	225,659	1,490,000
1950	694,090	696,472	113,500	48,482	26,902*	280,299	1,860,000
1951	605,346	814,406	105,000	52,136	29,777*	278,262	1,885,000
1952	584,238	750,494	96,500	63,134	35,475*	261,211	1,790,000
1953	574,390	692,164	98,610	74,545	35,318*	250,182	1,725,000
1954	584,435	738,670	93,935	78,024	26,833*	280,112	1,802,500
1955	639,128	733,786	93,830	80,172	6,000*	344,584	1,897,500
1956	568,550	686,667	95,389	89,072	22,457	336,015	1,857,000
1957:							
May	45,519	48,455	7,359	6,995	2,069	24,603	135,000
June	51,293	49,970	6,510	7,291	1,554	28,380	145,000
July	56,533	86,863	9,551	8,691	2,379	30,983	195,000
Aug.	56,235	74,194	11,040	8,718	1,905	22,908	175,000
Sept.	52,923	59,520	9,234	7,647	500	27,674	157,500
Oct.	55,912	55,012	8,898	....	500	44,678	165,000
Nov.	57,106	46,630	8,941	....	500	41,823	155,000

Source: International Rubber Study Group. * Estimated.

World Consumption of Natural and Synthetic Rubber

(Including Latex)

(Long Tons)

Year	United States	United Kingdom	Canada	Europe*	Rest of World*	Total*
1944	710,783	86,977	34,310	132,500	160,690	1,125,000
1945	799,009	91,047	41,836	87,500	108,164	1,127,500
1946	1,039,296	126,770	39,196	145,000	115,804	1,467,500
1947	1,122,327	156,399	61,452	242,500	153,548	1,735,000
1948	1,069,404	196,286	62,121	392,000	182,379	1,902,500
1949	988,903	186,622	56,362	446,500	207,388	1,887,500
1950	1,258,557	222,425	68,695	448,500	287,055	2,285,000
1951	1,214,298	238,101	70,809	476,500	314,941	2,312,500
1952	1,261,413	202,179	67,099	550,000	254,901	2,335,000
1953	1,338,309	211,453	73,394	521,000	343,606	2,500,000
1954	1,233,012	247,612	71,656	544,250	408,094	2,505,000
1955	1,529,699	266,804	84,528	630,000	464,250	2,980,000
1956	1,436,482	232,345	91,458	775,500	489,215	3,025,000
1957:						
May	126,753	19,341	8,319	64,750	48,337	267,500
June	111,738	22,745	7,626	67,250	48,141	257,500
July	108,833	18,246	6,426	63,000	55,995	252,500
Aug.	124,204	12,708	5,252	60,500	49,836	252,500
Sept.	121,326	24,449	7,131	66,250	48,344	267,500
Oct.	137,602	20,783	7,767	.....	58,848	275,000
Nov.	118,966	20,154	7,573	.....	110,807	257,500

Source: International Rubber Study Group. * Estimated.

Rim Production

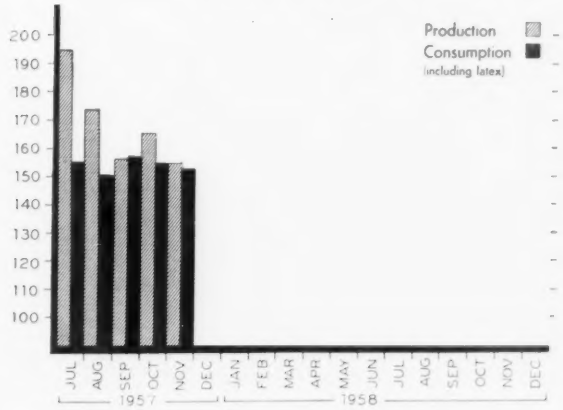
	1953	1954	1955	1956	1957
Passenger Car	31,318,461	25,952,322	38,092,080	27,109,610	27,301,567
Truck & Bus	5,228,831	4,463,689	6,642,329	6,315,428	5,468,223
Agricultural	1,943,489	1,279,040	1,931,768	1,416,938	1,368,127
Earth Mover	24,685	21,536	38,849	88,812	67,289
Total	38,514,954	31,734,587	46,705,036	34,930,788	34,205,206

	1957 Aug.	Sept.	Oct.	Nov.	Dec.	1958 Jan.
Passenger Car	2,349,616	1,600,648	1,929,954	2,333,288	2,210,932	2,330,499
Truck & Bus	395,313	385,062	322,661	350,177	331,890	333,788
Agricultural	72,373	71,393	90,504	79,302	96,256	101,389
Earth Mover	3,680	5,575	1,890	9,677	2,793	3,827
	2,820,982	2,062,668	2,345,009	2,772,384	2,641,871	2,769,503

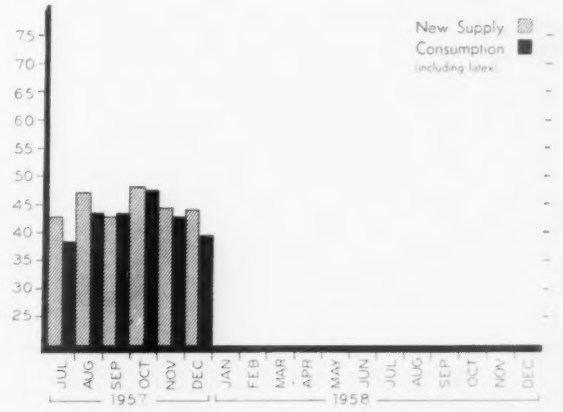
Source: The Tire & Rim Association, Inc.

STATISTICS at a glance

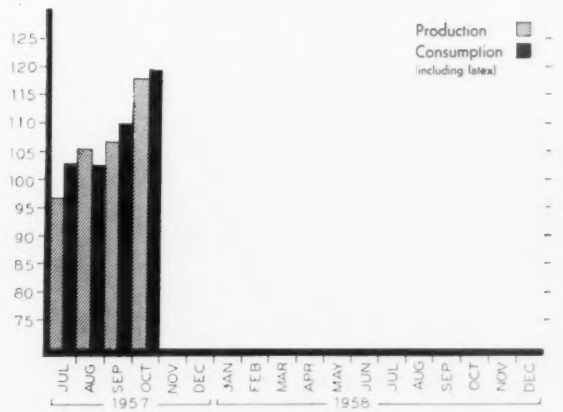
NATURAL RUBBER—WORLD
(thousands of long tons)



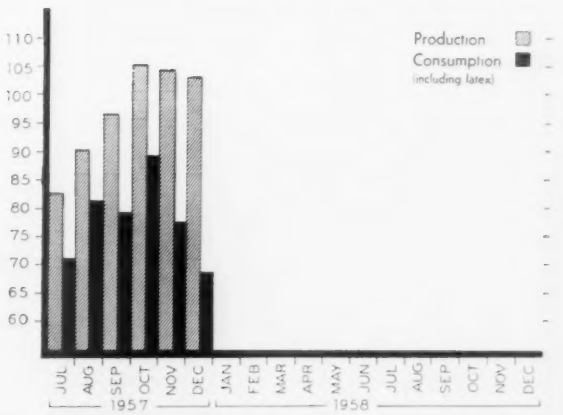
NATURAL RUBBER—UNITED STATES
(thousands of long tons)



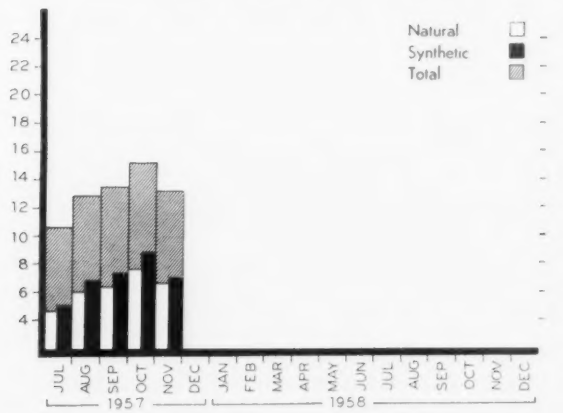
SYNTHETIC RUBBER—WORLD
(thousands of long tons)



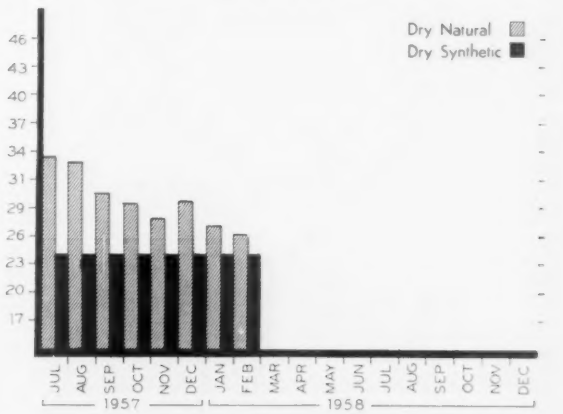
SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)



LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)



PRICES—NATURAL AND SYNTHETIC
(cents per pound)



Synthetic Rubber in the United States

(All Quantities in Long Tons)

New Supply

Year	GR-S	Neoprene	Butyl	N-Type	Total
1949	**310,539**	**35,215**	**54,046**	**11,072**	**410,932**
1950	**378,887**	**50,067**	**60,915**	**12,037**	**501,906**
1951	**704,529**	**58,907**	**76,475**	**15,333**	**855,244**
1952	**654,854**	**65,745**	**81,630**	**16,228**	**818,447**
1953	**680,728**	**80,495**	**79,801**	**20,198**	**861,222**
1954	**490,405**	**69,150**	**58,802**	**21,396**	**639,753**
1955	801,145	91,357	56,179	32,623	982,304
1956	876,982	99,412	75,873	34,547	1,086,814
1957:					
Jan.	76,224	9,432	6,366	2,957	94,999
Feb.	66,023	9,004	5,664	2,963	83,654
Mar.	76,546	8,031	6,460	3,320	94,357
Apr.	65,706	8,902	5,890	2,449	82,947
May	77,542	9,235	6,145	2,597	95,519
June	68,297	9,678	4,474	2,576	85,025
July	68,295	8,591	2,007	2,617	81,710
Aug.	76,585	9,033	5,475	2,773	93,870
Sept.	76,502	9,726	6,135	2,875	95,238
Oct.	87,709	9,545	6,085	4,002	107,341
Nov.	87,152	9,976	6,099	2,803	106,030
Dec.	85,223	9,568	6,469	2,519	103,779

Consumption

1950	**416,230**	**43,781**	**66,348**	**11,930**	**538,289**
1951	**626,444**	**48,887**	**70,500**	**13,066**	**758,897**
1952	**666,420**	**55,522**	**71,229**	**13,866**	**807,037**
1953	**624,181**	**65,900**	**77,826**	**16,929**	**784,836**
1954	**500,345**	**57,203**	**61,464**	**17,715**	**636,727**
1955	741,997	72,876	53,991	26,035	894,899
1956	727,789	74,887	49,615	24,976	877,267
1957:					
Jan.	70,978	7,237	5,028	2,247	85,490
Feb.	64,322	6,235	4,581	2,122	77,260
Mar.	67,853	6,559	4,998	2,240	81,650
Apr.	63,280	6,295	4,651	2,129	76,355
May	66,774	6,441	4,902	2,125	80,242
June	58,479	5,816	4,198	1,963	70,456
July	58,021	5,231	4,146	1,646	69,044
Aug.	66,089	6,502	4,461	2,220	79,272
Sept.	64,505	6,351	4,654	2,141	77,651
Oct.	73,850	7,194	5,343	2,433	88,820
Nov.	62,635	6,136	4,521	2,110	75,402
Dec.	56,345	5,531	3,884	1,749	67,509

Exports

1950	**900**	**4,826**	**31**	**1,895**	**7,652**
1951	**483**	**6,825**	**216**	**1,725**	**9,249**
1952	**9,467**	**9,813**	**126**	**2,695**	**22,101**
1953	**7,692**	**11,494**	**237**	**3,245**	**22,668**
1954	**11,069**	**12,062**	**2,831**	**4,155**	**30,117**
1955	60,704	18,098	9,895	4,593	93,290
1956	112,366	21,909	8,699	6,194	149,168
1957:					
Jan.	13,989	2,500	207	540	17,236
Feb.	13,353	2,505	439	482	16,779
Mar.	13,664	2,466	1,014	781	17,925
Apr.	10,625	2,244	372	620	13,861
May	12,208	2,480	603	517	15,808
June	13,886	2,315	762	492	17,455
July	14,444	3,426	1,169	631	19,670
Aug.	13,795	2,786	758	478	17,817
Sept.	11,625	1,964	540	396	14,525
Oct.	12,200	2,588	1,261	467	16,516
Nov.	12,639	2,521	809	410	16,379

Stocks

1949	**77,731**	**4,654**	**12,224**	**3,433**	**98,042**
1950	**36,942**	**5,733**	**7,243**	**2,840**	**52,758**
1951	**105,271**	**8,379**	**12,481**	**3,821**	**129,912**
1952	**83,861**	**8,535**	**22,716**	**3,875**	**118,987**
1953	**135,153**	**11,480**	**24,866**	**4,346**	**175,845**
1954	**115,499**	**11,349**	**19,267**	**4,280**	**150,395**
1955	108,989	12,220	10,500	6,030	137,739
1956	151,763	14,077	28,744	7,934	202,518
1957:					
Jan.	143,177	13,073	29,810	7,664	193,724
Feb.	134,587	12,705	29,951	7,565	184,808
Mar.	131,255	11,949	30,814	7,795	181,813
Apr.	122,764	12,064	31,536	7,247	173,611
May	121,638	13,010	31,812	6,981	173,441
June	120,694	13,822	31,569	7,085	173,230
July	113,143	15,172	28,208	7,125	163,648
Aug.	111,962	14,603	28,339	6,784	161,688
Sept.	109,417	14,751	29,132	7,207	160,507
Oct.	113,382	15,181	29,008	7,134	164,705
Nov.	124,432	16,453	29,702	7,380	177,967
Dec.	142,763	19,217	31,748	7,421	201,149

Source: U. S. Department of Commerce.

Natural and Synthetic Rubber Latex in the United States

(All Quantities in Long Tons)

New Supply

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Grand Total
1945	4,768	15,176	7,077	.....	22,253	27,021
1946	8,012	24,810	13,595	.....	38,405	46,417
1947	17,675	22,474	6,089	.....	28,563	46,238
1948	32,630	21,494	5,022	.....	26,516	59,146
1949	29,974	21,357	3,651	.....	25,008	54,982
1950	54,401	31,339	5,725	.....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955	92,754	69,364	10,432	10,798	90,594	183,348
1956	72,013	69,720	10,642	10,650	91,012	163,025
1956:						
Nov.	4,762	6,053	886	1,175	8,114	12,876
Dec.	6,661	7,101	967	1,012	9,080	15,741
1957:						
Jan.	6,460	7,270	905	960	9,135	15,595
Feb.	4,342	6,491	724	1,035	8,250	12,592
Mar.	5,856	7,268	924	1,127	9,319	15,175
Apr.	8,812	6,348	976	881	8,205	17,017
May	5,794	5,495	1,082	933	7,510	13,304
June	4,809	5,241	819	886	6,946	11,755
July	6,243	4,646	572	844	6,062	12,305
Aug.	6,834	6,816	874	608	8,298	15,132
Sept.	5,516	5,649	917	1,285	7,851	13,367
Oct.	8,351	6,876	885	1,133	8,894	17,245
Nov.	6,496	6,515	1,021	994	8,530	15,026
Dec.	4,833	5,915	704	734	7,353	12,186

Consumption[1]

1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956	74,082	62,762	8,708	8,021	79,491	153,573
1956:						
Nov.	6,431	5,406	723	659	6,788	13,219
Dec.	6,648	5,781	676	597	7,054	13,702
1957:						
Jan.	6,994	6,288	856	841	7,985	14,979
Feb.	6,398	5,894	758	708	7,360	13,758
Mar.	7,081	6,370	784	799	7,953	15,034
Apr.	6,434	5,554	772	710	7,036	13,470
May	5,867	5,114	814	731	6,659	12,526
June	5,445	4,790	736	610	6,136	11,581
July	5,180	4,269	677	480	5,426	10,606
Aug.	6,499	5,758	784	823	7,365	13,864
Sept.	6,645	5,676	712	753	7,141	13,786
Oct.	7,250	6,556	788	857	8,201	15,451
Nov.	6,783	5,776	725	712	7,213	13,996
Dec.	6,006	5,194	651	499	6,344	12,350

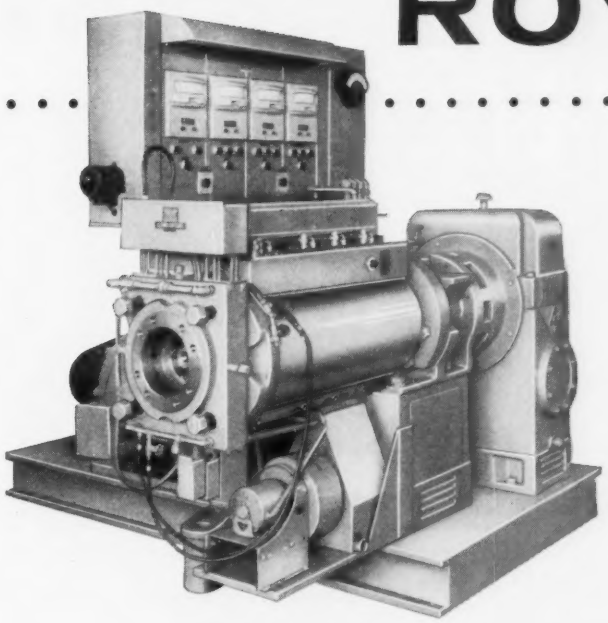
Stocks at End of Period

1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955	13,203	6,980	1,236	1,807	10,203	23,406
1956	12,064	7,451	1,384	1,558	10,393	22,457
1956:						
Nov.	11,148	6,282	1,233	1,939	9,454	20,602
Dec.	12,064	7,451	1,384	1,558	10,393	22,457
1957:						
Jan.	11,831	7,191	1,329	1,936	10,456	22,287
Feb.	9,940	7,415	1,169	2,051	10,635	20,575
Mar.	10,173	7,689	1,170	2,157	11,016	21,189
Apr.	12,064	8,096	1,183	1,836	11,115	23,179
May	11,733	7,885	1,407	1,710	11,002	22,735
June	10,931	8,139	1,377	2,001	11,517	22,448
July	12,073	8,045	1,296	1,953	11,294	23,367
Aug.	13,535	7,997	1,309	1,545	10,851	24,386
Sept.	12,315	7,566	1,141	1,700	10,407	22,722
Oct.	12,399	7,254	1,142	1,723	10,119	22,518
Nov.	12,316	7,558	1,265	1,927	10,750	23,066
Dec.	14,299	8,662	1,155	1,530	11,347	25,646

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.

ROYLE

SPIROD® EXTRUDERS



These all electric extruders with radiant heat and high velocity evaporative cooling are designed to process either plastic or rubber compounds. The result of more than three quarters of a century of experience — Royle pioneered the extrusion process in 1880— in the design and construction of extruding machines time tested features have been built into Spirod to assure dependability.

Write for Bulletin #463

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

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London, England	Home Office	Akron, Ohio	Downey, Cal.	Tokyo, Japan
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TRENTON 8, NEW JERSEY

Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1951 (total)	**32,153**	**44,612**	**1,677**	**78,442**	**83,405**	**8,765**
Passenger Car	**26,729**	**34,226**	**723**	**61,678**	**65,546**	**6,973**
Truck and Bus	**5,424**	**10,386**	**954**	**16,764**	**17,859**	**1,791**
1952 (total)	**29,484**	**54,342**	**1,520**	**85,346**	**90,411**	**14,110**
Passenger Car	**24,106**	**45,458**	**741**	**70,305**	**74,341**	**11,251**
Truck and Bus	**5,378**	**8,884**	**779**	**15,041**	**16,070**	**2,859**
1953 (total)	**37,949**	**55,124**	**1,543**	**94,617**	**96,150**	**15,720**
Passenger Car	**33,106**	**45,798**	**809**	**79,713**	**81,455**	**13,044**
Truck and Bus	**4,843**	**9,326**	**734**	**14,904**	**14,696**	**2,676**
1954 (total)	**33,333**	**55,155**	**1,753**	**90,241**	**89,141**	**14,762**
Passenger Car	**29,741**	**47,044**	**928**	**77,713**	**76,794**	**12,217**
Truck and Bus	**3,591**	**8,111**	**826**	**12,528**	**12,347**	**2,545**
1955 (total)	**47,374**	**59,246**	**1,879**	**108,499**	**112,178**	**18,778**
Passenger Car	**42,574**	**50,189**	**966**	**93,730**	**97,223**	**15,963**
Truck and Bus	**4,800**	**9,057**	**912**	**14,769**	**14,955**	**2,815**
1956 (total)	35,422	62,146	1,757	99,325	100,406	79,872
Passenger Car	30,873	53,252	875	85,000	85,546	16,494
Truck and Bus	4,548	8,894	883	14,325	14,859	3,378
1957 (total)	36,765	65,150	1,733	103,649	106,940	250,536
Passenger Car	32,725	56,603	889	90,217	93,542	210,146
Truck and Bus	4,053	8,546	846	13,432	13,398	40,384
1956:						
Dec. (total)	3,579	3,803	166	7,548	8,556	19,872
Passenger Car	3,277	3,220	90	6,587	7,425	16,494
Truck and Bus	301	583	76	961	1,130	3,378
1957:						
Jan. (total)	3,496	5,195	183	8,874	9,504	20,490
Passenger Car	3,192	4,519	99	7,810	8,296	16,978
Truck and Bus	305	677	83	1,065	1,208	3,512
Feb. (total)	3,361	5,051	127	8,539	9,169	21,008
Passenger Car	3,017	4,453	68	7,538	8,047	17,376
Truck and Bus	344	598	59	1,001	1,122	3,633
Mar. (total)	3,381	5,579	154	9,114	9,766	21,743
Passenger Car	3,051	4,875	80	8,007	8,630	18,068
Truck and Bus	340	704	74	1,107	1,136	3,675
Apr. (total)	3,246	5,989	146	9,381	8,950	21,308
Passenger Car	2,809	5,218	78	8,104	7,878	17,821
Truck and Bus	438	770	69	1,277	1,072	3,486
May (total)	3,230	5,786	134	9,151	9,490	21,630
Passenger Car	2,831	5,166	60	8,057	8,312	18,050
Truck and Bus	399	620	74	1,094	1,178	3,580
June (total)	2,993	6,191	127	9,310	8,489	20,783
Passenger Car	2,623	5,476	63	8,162	7,462	17,322
Truck and Bus	370	715	64	1,148	1,027	3,461
July (total)	3,068	6,646	126	9,840	8,443	19,316
Passenger Car	2,719	5,826	65	8,611	7,449	16,097
Truck and Bus	349	819	61	1,229	994	3,219
Aug. (total)	3,214	6,488	130	9,833	8,917	18,477
Passenger Car	2,886	5,675	66	8,627	7,801	15,348
Truck and Bus	328	813	65	1,206	1,117	3,129
Sept. (total)	1,688	5,902	133	7,723	8,641	19,393
Passenger Car	1,398	5,096	70	6,564	7,535	16,310
Truck and Bus	290	805	63	1,159	1,105	3,083
Oct. (total)	2,620	5,351	182	8,154	9,708	20,985
Passenger Car	2,298	4,392	88	6,778	8,437	17,998
Truck and Bus	322	960	94	1,375	1,271	2,987
Nov. (total)	3,398	3,630	143	7,171	8,248	22,178
Passenger Car	3,098	3,049	74	6,220	7,098	18,960
Truck and Bus	301	581	70	951	1,150	3,211
Dec. (total)	3,070	3,342	148	6,559	7,615	23,225
Passenger Car	2,803	2,858	78	5,739	6,597	19,818
Truck and Bus	267	484	70	820	1,018	3,408

Source: The Rubber Manufacturers Association, Inc.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1938	2,000,985	485,852	2,486,837	**1948**	**3,909,270**	**1,363,856**	**5,273,126**
1939	2,866,796	704,308	3,571,104	**1949**	**5,108,841**	**1,123,736**	**6,232,577**
1940	3,692,328	721,637	4,413,965	**1950**	**6,665,836**	**1,332,263**	**7,998,099**
1941	3,744,500	875,381	4,619,681	**1951**	**5,337,729**	**1,420,432**	**6,758,161**
1942	220,814	133,083	353,897	**1952**	**4,320,794**	**1,212,790**	**5,533,584**
1943	0	4,501	4,501	**1953**	**6,121,787**	**1,202,196**	**7,323,983**
1944	0	124,819	124,819	**1954**	**5,558,897**	**1,038,045**	**6,596,942**
1945	83,792	313,643	397,435	**1955**	**7,920,186**	**1,245,018**	**9,165,204**
1946	2,148,699	930,760	3,079,429	**1956**	**5,816,109**	**1,100,417**	**6,916,526**
1947	3,558,178	1,220,634	4,778,812	**1957**	**6,113,344**	**1,097,006**	**7,210,350**
1956:							
Jan.	591,032	98,968	690,000	July	440,980	80,731	521,711
Feb.	560,924	102,384	663,308	Aug.	417,020	85,827	502,847
Mar.	583,169	106,379	689,548	Sept.	203,888	71,299	275,187
Apr.	552,881	101,081	653,962	Oct.	352,140	92,684	444,824
May	474,010	96,114	570,124	Nov.	576,708	90,246	666,954
June	445,758	91,791	537,549	Dec.	617,599	82,913	700,512
1957:							
Jan.	628,045	91,117	719,162	July	484,718	96,048	580,766
Feb.	570,023	91,767	661,790	Aug.	521,282	90,152	611,434
Mar.	585,734	91,703	676,437	Sept.	318,279	63,131	381,410
Apr.	541,733	105,175	646,908	Oct.	291,064	88,879	379,943
May	537,112	102,312	639,424	Nov.	583,783	94,574	678,357
June	496,329	94,321	590,650	Dec.	555,242	87,327	642,569

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1946	**15,327**	**59,357**	**1,424**	**76,108**	**77,251**	**3,820**
1947	**25,046**	**46,560**	**2,483**	**74,088**	**79,181**	**8,059**
1948	**26,833**	**40,548**	**1,119**	**68,499**	**70,033**	**9,641**
1949	**31,521**	**31,450**	**887**	**63,858**	**65,114**	**10,657**
1950	**41,240**	**42,671**	**811**	**84,723**	**80,179**	**...**
1951	**32,151**	**32,284**	**1,071**	**65,507**	**67,249**	**10,094**
1952	**29,451**	**32,985**	**1,014**	**63,449**	**65,073**	**12,036**
1953	**37,957**	**36,072**	**878**	**74,907**	**74,425**	**11,874**
1954	**25,071**	**35,576**	**945**	**61,593**	**48,279**	**9,519**
1955	**5,001**	**33,387**	**1,001**	**39,389**	**35,900**	**6,833**
1956	3,100	32,358	1,040	36,498	34,405	6,109
1957	3,046	35,687	1,076	39,806	39,774	80,077
1957:						
Jan.	234	3,494	101	3,829	3,364	5,789
Feb.	267	2,964	61	3,291	3,362	5,960
Mar.	240	3,058	100	3,397	3,822	6,540
Apr.	311	2,708	85	3,104	3,428	6,969
May	301	2,829	84	3,214	3,548	7,422
June	275	3,128	69	3,472	3,025	6,946
July	258	3,364	86	3,708	2,941	6,287
Aug.	243	3,358	82	3,683	3,134	5,966
Sept.	213	3,180	90	3,483	3,365	6,174
Oct.	242	2,809	121	3,172	3,764	6,909
Nov.	237	2,403	96	2,736	3,243	7,444
Dec.	225	2,392	101	2,717	2,778	7,671

Source: The Rubber Manufacturers Association, Inc.

Vinyl and Vinyl Copolymer Resins—Sales

(Thousands of Pounds—Resin Content)

	Polyvinyl Chloride and Copolymer Resins: Film	Sheeting	Molding & Extrusion	Textile & Paper Treating	Flooring	Protective Coatings	All Other Uses	All Other Vinyl Resins: Adhesives	All Other Uses	Grand Total
1953	**63,691**	**62,385**	**129,215**	**52,353**	**22,152**	**22,823**	**27,790**	**22,411**	**77,478**	**480,299**
1954	**69,943**	**56,588**	**147,284**	**49,546**	**34,890**	**23,676**	**35,148**	**26,609**	**74,090**	**517,773**
1955	**83,276**	**51,424**	**183,736**	**64,223**	**56,357**	**27,439**	**53,868**	**31,853**	**105,644**	**657,821**
1956	78,063	55,598	206,726	62,931	65,384	28,522	71,859	36,565	115,151	720,799
1957	90,543	56,344	216,517	66,392	81,357	31,519	50,637	41,665	113,396	748,370
1956:										
Oct.	8,581	5,341	21,339	6,384	6,790	2,568	5,984	3,231	10,773	70,992
Nov.	7,002	4,774	19,895	5,888	6,253	2,639	6,128	3,115	10,242	65,936
Dec.	5,829	3,990	18,279	5,416	5,810	2,672	7,063	2,429	9,297	60,785
1957:										
Jan.	8,094	5,761	18,505	6,197	5,958	3,077	3,438	2,988	10,408	64,426
Feb.	8,669	4,564	19,805	5,137	6,221	2,682	3,258	3,255	9,529	63,120
Mar.	8,589	5,272	20,792	5,440	6,879	2,798	4,173	3,372	10,060	67,375
Apr.	7,036	4,191	18,393	4,616	7,890	3,495	4,254	4,211	8,975	63,061
May	7,641	3,765	18,218	4,628	7,519	3,227	4,388	3,404	10,371	63,161
June	7,098	3,861	17,195	4,688	6,245	2,362	3,791	4,467	9,851	59,558
July	6,342	4,362	14,340	5,371	6,030	2,755	2,872	3,236	7,976	53,284
Aug.	7,121	4,941	17,962	6,884	7,553	2,515	4,252	3,677	9,011	63,916
Sept.	9,406	4,987	18,653	6,542	7,156	2,363	4,189	3,191	8,771	65,258
Oct.	10,747	5,102	21,712	6,802	7,506	2,256	4,466	3,771	10,887	73,249
Nov.	5,569	5,142	16,940	6,151	6,224	1,916	6,211	3,197	9,265	60,615
Dec.	4,231	4,396	14,002	3,936	6,176	2,073	5,345	2,896	8,292	51,347

Source: Chemical Division, U. S. Tariff Commission.

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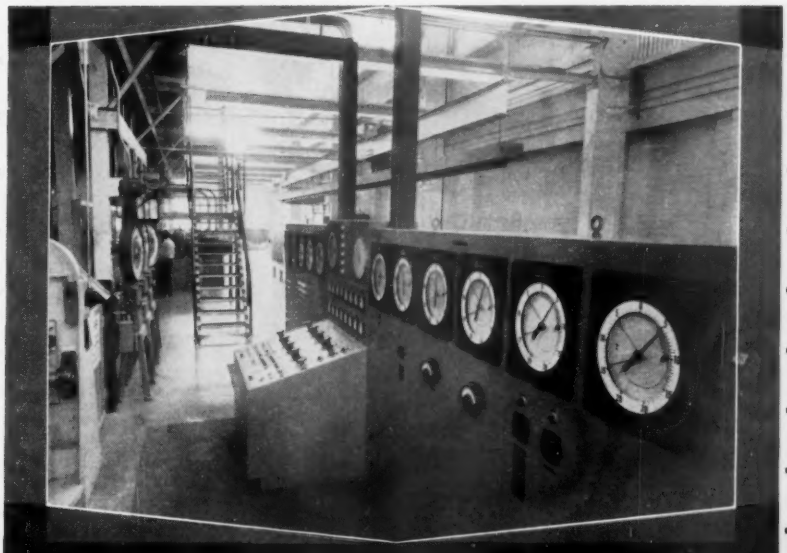

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WITH INSTRUMENTATION FOR THE BEST IN PROCESSING
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EXPORT REPRESENTATIVE: GILLESPIE & CO. OF N. Y., 96 WALL ST., NEW YORK 5, N. Y.

Rubber Industry Employment Earnings and Hours

All Rubber Products

Mo.	1956 Production Workers (thousands)	1956 Average Weekly Earnings	1956 Average Weekly Hours	1956 Average Hourly Earnings	1957 Production Workers (thousands)	1957 Average Weekly Earnings	1957 Average Weekly Hours	1957 Average Hourly Earnings
Jan.	229.5	$87.91	40.7	$2.16	216.0	91.21	40.9	2.23
Feb.	224.5	85.81	40.1	2.14	212.6	90.80	40.9	2.22
Mar.	220.8	84.93	39.5	2.15	211.4	89.28	40.4	2.21
Apr.	218.7	85.79	39.9	2.15	191.3	87.60	40.0	2.19
May	216.0	86.18	39.9	2.16	204.2	88.80	40.0	2.22
June	208.5	84.93	39.5	2.15	196.8	91.21	40.9	2.23
July	208.0	86.15	39.7	2.17	199.8	94.16	41.3	2.28
Aug.	210.8	87.64	40.2	2.18	204.3	92.84	40.9	2.27
Sept.	215.4	89.51	40.5	2.21	206.4	92.97	40.6	2.29
Oct.	220.0	90.17	40.8	2.21	209.2	93.03	40.1	2.32
Nov.	198.9	88.29	40.5	2.18	206.9	....	...	...
Dec.	221.5	93.15	41.1	2.25	....	....	...	...

Tires and Tubes

Jan.	93.7	101.00	40.4	2.50	87.4	107.64	41.4	2.60
Feb.	93.2	97.71	39.4	2.48	86.8	106.19	41.0	2.59
Mar.	92.6	97.25	38.9	2.50	86.9	102.40	40.0	2.56
Apr.	91.8	98.00	39.2	2.50	71.1	103.46	40.1	2.58
May	91.6	99.65	39.7	2.51	84.9	103.46	40.1	2.58
June	90.1	98.25	39.3	2.50	78.2	107.23	41.4	2.59
July	90.0	98.14	39.1	2.51	83.9	112.20	42.5	2.64
Aug.	89.8	101.20	40.0	2.53	84.2	107.83	41.0	2.63
Sept.	91.6	102.51	40.2	2.55	84.4	107.20	40.3	2.66
Oct.	91.7	102.66	40.1	2.56	84.5	105.45	39.2	2.69
Nov.	74.8	103.53	40.6	2.55	....	....	...	...
Dec.	93.2	109.25	41.7	2.62	....	....	...	...

Rubber Footwear

Jan.	21.0	74.37	40.2	1.85	18.3	71.76	39.0	1.84
Feb.	20.9	74.74	40.4	1.85	17.8	72.10	39.4	1.83
Mar.	20.7	71.34	39.2	1.82	17.8	72.68	39.5	1.84
Apr.	20.3	72.25	39.7	1.82	17.5	70.64	38.6	1.83
May	20.0	72.25	39.7	1.82	17.3	71.92	39.3	1.83
June	19.4	70.53	39.4	1.79	17.4	72.29	39.5	1.83
July	18.9	71.28	39.6	1.80	16.8	72.13	39.2	1.84
Aug.	19.2	70.35	39.3	1.79	17.2	73.05	39.7	1.84
Sept.	19.3	71.71	39.4	1.82	17.6	74.45	39.6	1.88
Oct.	91.1	71.71	39.4	1.82	17.6	76.21	39.9	1.91
Nov.	18.7	71.55	39.1	1.83	....	....	...	...
Dec.	18.4	73.26	39.6	1.85	....	....	...	...

All Other Rubber Products

Jan.	114.8	79.73	41.1	1.94	110.3	81.39	40.9	1.99
Feb.	110.4	77.95	40.6	1.92	108.0	81.18	41.0	1.98
Mar.	107.5	76.99	40.1	1.92	106.7	81.19	40.8	1.99
Apr.	106.6	77.95	40.6	1.92	102.7	79.60	40.2	1.98
May	104.4	76.99	40.1	1.92	102.0	79.80	40.1	1.99
June	99.0	76.02	39.8	1.91	101.2	81.81	40.7	2.01
July	99.1	77.78	40.3	1.93	99.1	82.62	40.7	2.03
Aug.	101.8	78.76	40.6	1.94	102.9	83.84	41.1	2.04
Sept.	104.5	81.18	41.0	1.98	104.4	85.08	41.1	2.07
Oct.	109.2	82.98	41.7	1.99	107.1	85.89	40.9	2.10
Nov.	105.4	79.98	40.6	1.97	....	....	...	...
Dec.	109.9	82.59	41.5	1.99	....	....	...	...

Source: U. S. Department of Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1951	1952	1953	1954	1955	1956	1957	1958
Jan.	45.04	42.96	33.24	34.15	35.07	35.24	34.82	36.31
Feb.	(a)	41.64	33.76	35.00	35.04	36.26	34.82	35.83
Mar.	46.06	41.70	34.10	35.23	34.33	36.70	35.35	....
Apr.	46.60	41.79	33.85	35.22	34.23	36.81	35.43	....
May	46.06	39.98	34.30	35.34	34.80	36.65	35.40	....
June	46.06	41.31	34.11	35.17	34.83	36.67	35.45	....
July	46.21	40.37	34.20	35.37	34.61	35.43	35.49	....
Aug.	35.93	40.42	33.82	35.19	34.53	34.31	35.15	....
Sept.	36.20	39.75	33.69	35.46	33.85	34.35	34.74	....
Oct.	38.13	37.52	33.53	35.24	33.93	34.45	35.09	....
Nov.	42.70	35.59	33.60	34.80	34.87	34.56	36.06	....
Dec.	43.32	33.76	33.52	35.03	34.95	34.56	36.50	....
Average for Year	42.43	39.71	33.81	35.10	34.59	35.50	35.36	....

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

Production Index for the Rubber Industry

(1947-1949 = 100)

(Based on man-hours)

	1955	1956	1957		1955	1956	1957
Jan.	145	147	145	July	137	125	133
Feb.	144	140	145	Aug.	138	135	144
Mar.	146	135	142	Sept.	142	132	137
Apr.	147	136	131	Oct.	147	134	136
May	146	127	130	Nov.	147	126	132
June	149	120	129	Dec.	144	137	119

Sales by the Rubber Industry

(in Millions of Dollars*)

	1955	1956	1957		1955	1956	1957
Jan.	424	415	496	July	471	459	514
Feb.	440	445	495	Aug.	456	436	514
Mar.	466	451	476	Sept.	456	429	481
Apr.	445	445	490	Oct.	447	454	490
May	465	464	481	Nov.	482	463	431
June	465	450	458	Dec.	465	461	...

Rubber Manufacturers' Inventories

(in Millions of Dollars*)

	1955	1956	1957		1955	1956	1957
Jan.	790	935	1,047	July	853	987	1,043
Feb.	782	970	1,036	Aug.	863	1,007	1,074
Mar.	805	979	1,030	Sept.	874	1,007	1,074
Apr.	784	970	1,031	Oct.	902	1,002	1,097
May	810	985	1,024	Nov.	935	1,024	1,101
June	850	975	1,027	Dec.	934	998	...

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

No. 1 R.S.S.—Annual Average Prices

(New York Market—Cents per Pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1916	102	55	72.50	1937	26⅞	14	19.39
1917	90	52	72.23	1938	17⅞	10¾	14.64
1918	70	40	60.15	1939	24	14⅛	17.57
1919	57	38½	48.70	1940	24	18¼	20.10
1920	56½	16	36.30	1941	24⅞	19⅛	22.40
1921	21¼	11½	16.36	1942	22½	22½	22.50
1922	28⅛	13⅝	17.50	1943	22½	22½	22.50
1923	37⅛	24¼	29.45	1944	22½	22½	22.50
1924	40⅝	17⅝	26.20	1945	22½	22½	22.50
1925	121	34⅛	72.46	1946	22½	22½	22.50
1926	88½	36¾	48.50	1947	25	14	20.00
1927	41¾	33	37.72	1948	25	18	21.99
1928	41¾	17	22.48	1949	19¾	15⅞	17.57
1929	26⅞	15½	20.55	1950	86	18	41.10
1930	16½	7½	11.98	1951	76	52	(a)
1931	8⅝	4¼	6.17	1952*	33	26½	29.15
1932	4¾	2½	3.49	1953	31⅞	19¾	24.21
1933	9⅞	2⅞	5.96	1954	34½	19½	23.61
1934	15⅞	8¾	12.92	1955	52	29⅜	39.16
1935	13¾	10½	12.37	1956	45	26½	34.24
1936	23	13½	16.41	1957	37⅜	26⅝	31.13

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 66c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

No. 1 R.S.S.—Monthly Average Prices

(New York Market—Cents per pound)

	1951	1952	1953	1954	1955	1956	1957	1958
Jan.	71.21	....	29.40	20.22	33.92	41.70	33.32	27.15
Feb.	73.61	....	27.57	19.98	34.90	33.68	30.43	26.32
Mar.	72.05	....	26.59	20.16	31.08	33.68	31.76	....
Apr.	....	....	24.66	22.06	31.75	31.74	32.23	....
May	....	....	25.52	21.96	31.35	29.61	32.12	....
June	....	....	24.42	23.01	34.74	30.54	32.80	....
July	....	30.52	23.64	24.12	40.84	33.91	32.88	....
Aug.	....	29.36	23.36	23.26	45.85	35.69	32.13	....
Sept.	....	27.42	23.06	23.99	48.27	32.64	29.94	....
Oct.	....	27.26	20.82	26.57	43.81	32.68	29.24	....
Nov.	....	29.25	20.58	28.07	44.95	35.18	27.47	....
Dec.	....	31.26	20.92	29.88	48.40	37.01	29.25	....
Average for Year	(a)	29.15	24.21	23.61	39.16	34.24	31.13	....

Note: (a) Free trading suspended March 31, 1951, and resumed on July 1, 1952.

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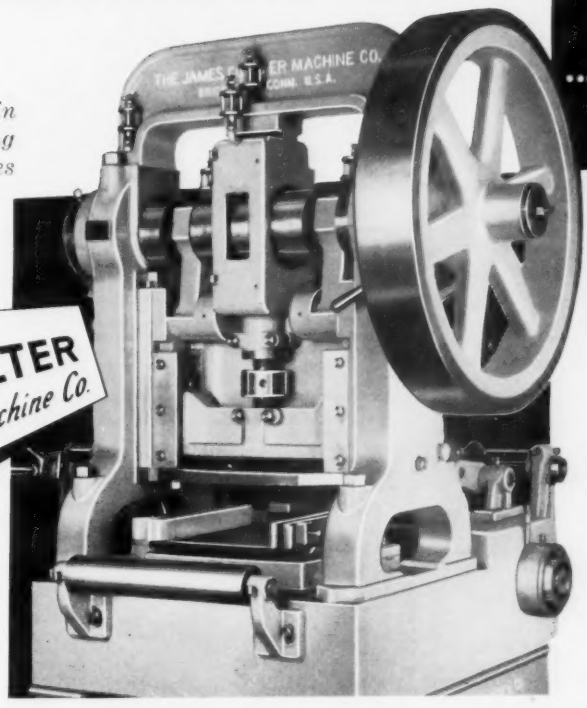

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Various Compounding Materials Consumed by the Rubber Industry

Material	1950	1951	1952	1953	1954	1955	1956
Antimony, Primary:							
Short tons	103[c]	19[c]	66[c]	20[c]	49[c]	78	.56
% of total	.007	.001	.004	.001	.004	.006	.013
Asphalt:[a]							
Short tons	26,819	21,414	33,288	.....	.....	.....	.....
% of total	0.3	0.3	0.4	.....	.....	.....	.....
Barite (Barytes):							
Short tons	19,000	15,000	18,000	21,000	20,000	25,104	22,101
% of total	3.31	2.13	2.0	2.0	2.0	2.0	2.0
Carbon Black:							
Short tons	515,184	530,614	537,273	566,797	511,813	643,430	622,325
% of total	92.9	93.9	93.1	94.4	93.5	93.5	95.5
Clay, Kaolin:							
Short tons	263,306	231,331	240,982	241,052	247,431	257,223	268,157
% of total	15.0	12.7	13.2	12.8	13.2	11.9	12.0
Clay, Fire & Stoneware:							
Short tons	9,500	.....	9,322	18,475	8,781	2,928	.....
% of total	0.1	.....	0.1	.2	.1	.2	.....
Lime:							
Short tons	908	1,126	2,000	1,631	1,555	1,465	2,487
% of total	.0002	(d)	(d)	(d)	(d)	(d)	(d)
Litharge:							
Short tons	3,047	2,641	2,109	2,230	1,768	1,947	2,266
% of total	1.7	1.1	1.5	1.4	1.3	1.3	1.7
Lithopone:							
Short tons	4,092	3,295	1,523	1,723	1,701	2,163	2,000[e]
% of total	3.9	3.2	2.5	3.3	3.9	5.0	5.0
Mica, Ground:							
Short tons	5,776	6,551	5,126	5,668	5,021	7,339	7,021
% of total	8.0	9.0	7.0	7.8	6.3	6.9	8.0
Sulfur:							
Short tons	75,000	84,000	84,000	89,600	84,000	89,600	89,600
% of total	1.3	1.4	1.4	1.4	1.3	1.2	1.1
Talc:[b]							
Short tons	75,900	70,970	64,476	61,408	58,139	38,309	30,253
% of total	12.0	11.2	10.9	10.0	9.7	5.4	5.0
Zinc Oxide:							
Short tons	82,944	71,507	72,774	78,439	71,058	86,677	90,000[e]
% of total	51.6	48.4	51.2	52.7	50.7	51.5	52.0

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	New Supply	Consumption: Tons	Consumption: % to Crude[a]	Exports	Stocks On Hand at End of Period
1941	**274,202**	**251,231**	**32.2**	**13,851**	**41,750**
1942	**286,007**[b]	**254,820**	**64.6**	**30,405**	**42,532**
1943	**304,058**[c]	**291,082**	**59.6**	**15,678**	**46,201**
1944	**260,631**[d]	**251,083**	**35.3**	**11,800**	**43,832**
1945	**243,309**	**241,036**	**30.2**	**13,413**	**28,155**
1946	**295,612**	**275,410**	**26.5**	**14,461**	**33,666**
1947	**291,395**	**288,395**	**24.8**	**14,556**	**35,943**
1948	**266,861**	**261,113**	**24.4**	**11,428**	**32,630**
1949	**224,029**	**226,679**	**22.5**	**10,637**	**28,263**
1950	**314,008**	**303,733**	**24.1**	**11,740**	**35,708**
1951	**366,700**	**346,121**	**26.6**	**14,722**	**45,082**
1952	**274,981**	**280,002**	**22.2**	**11,180**	**30,664**
1953	**298,336**	**285,050**	**21.3**	**11,597**	**32,319**
1954	**258,101**	**249,049**	**20.2**	**10,232**	**30,746**
1955	**326,649**	**312,781**	**20.4**	**13,988**	**31,498**
1956	**287,220**	**270,547**	**18.8**	**13,832**	**34,969**
1956:					
Dec.	20,673	20,737	17.7	902	34,969
1957:					
Jan.	25,103	24,053	17.5	1,288	34,552
Feb.	21,896	22,773	18.4	1,263	32,010
Mar.	25,088	24,633	19.0	1,298	30,975
Apr.	22,878	23,145	19.0	1,201	30,258
May	24,884	23,816	18.8	1,277	29,847
June	22,402	21,352	19.1	1,083	30,379
July	20,469	19,676	18.1	757	29,972
Aug.	20,432	22,429	18.1	917	28,521
Sept.	19,892	21,704	17.9	714	25,983
Oct.	26,419	24,925	18.1	1,230	27,171
Nov.	22,083	20,583	17.3	1,150	27,855
Dec.	20,050	18,196	17.2	....	29,301

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Cotton, Rayon and Nylon Tire Fabrics

(In Thousands of Pounds)

	Production: Rayon Tire Cord Not Woven	Production: Rayon Tire Cord Woven	Production: Cotton and Nylon Cord & Fabric[a]	Production: Chafer Fabrics (all fibers)	Production: Total Tire Cord and Fabric	Stocks[b]: Cotton and Nylon Cord & Fabric	Stocks[b]: Rayon Cord and Fabric
1956:							
Jan.-Mar.	23,707	74,833	29,298	14,176	129,199	10,185	48,936
Apr.-June	21,557	60,644	28,752	11,628	112,546	10,433	43,737
July-Sept.	18,698	56,961	26,349	7,958	102,575	11,094	44,376
Oct.-Dec.	20,071	55,655	28,493	9,497	104,921	12,500	38,060
Total	84,033	248,093	112,892	43,259	449,241	44,212	175,109
1957:							
Jan.-Mar.	21,853	68,825	31,393	11,028	123,182	11,844	37,153
Apr.-June	16,037	63,195	35,308	10,456	115,418	13,428	13,473
July-Sept.	10,509	54,968	33,477	9,147	100,091	13,305	36,388
Oct.-Dec.	9,216	58,392	32,827	10,176	101,687	14,909	29,632
Total	57,615	245,380	133,005	40,807	440,378	53,486	116,646

Source: Bureau of the Census, U. S. Department of Commerce.
Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1951	1952	1953	1954	1955	1956	1957
Jan.	80,670	86,863	89,634	89,852	96,397	100,642	109,295
Feb.	72,864	82,043	86,458	86,206	88,464	98,088	96,694
Mar.	86,962	87,065	98,158	101,549	105,684	112,412	113,166
Apr.	87,573	98,563	102,044	103,866	111,116	113,034	115,820
May	100,266	101,137	105,918	104,418	115,707	123,560	124,325
June	96,364	99,305	114,703	113,037	120,710	126,838	121,598
July	100,567	105,307	112,969	112,231	115,653	120,708	130,251
Aug.	101,453	102,954	109,124	110,223	121,816	125,847	128,808
Sept.	91,891	100,095	106,158	104,706	113,379	111,574	113,567
Oct.	100,209	103,689	106,037	105,607	112,558	119,204	119,334
Nov.	88,581	91,326	99,210	102,393	109,212	112,113	107,804
Dec.	84,551	95,817	100,225	104,258	111,034	108,096	.....
Total	1,091,951	1,154,254	1,230,629	1,238,346	1,321,730	1,372,116	.....

Source: U. S. Bureau of Mines.

U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

(All Quantities in Long Tons)

Year	Balata: Tons	Balata: Value	Jelutong: Tons	Jelutong: Value	Gutta-Percha & Other Guttas: Tons	Gutta-Percha & Other Guttas: Value
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1947	1,982	2,276,531	2,878	1,496,887	392	779,591
1948	1,195	805,078	3,401	2,377,765	423	542,788
1949	1,391	814,554	1,043	834,978	197	189,021
1950	2,117	1,589,885	1,789	1,515,162	541	745,418
1951	2,452	1,973,271	1,669	2,608,359	383	430,539
1952	988	762,994	1,636	2,094,983	282	385,890
1953	1,619	866,248	1,027	1,166,837	235	303,116
1954	949	504,065	2,196	2,624,926	417	511,055
1955	1,022	967,369	1,679	1,731,821	284	318,115
1956	1,396	1,111,165	1,851	1,909,447	290	309,615
1957:						
Jan.	38	17,911	141	155,467	15	10,684
Feb.	12	12,191	117	130,001	22	27,792
Mar.	89	51,830	150	178,499	16	7,894
Apr.	167	100,490	134	160,369	28	23,714
May	201	116,150	192	225,257	69	87,987
June	36	17,426	130	134,438	22	35,112
July	33	15,195	161	185,524	28	32,282
Aug.	19	10,245	126	138,622	7	5,544
Sept.	164	119,808	110	145,817	16	16,422
Oct.	97	68,547	166	207,038	5	9,259
Nov.	110	85,126	117	136,806	2	13,797

Source: U. S. Department of Commerce.

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"Help Wanted" continued on next page

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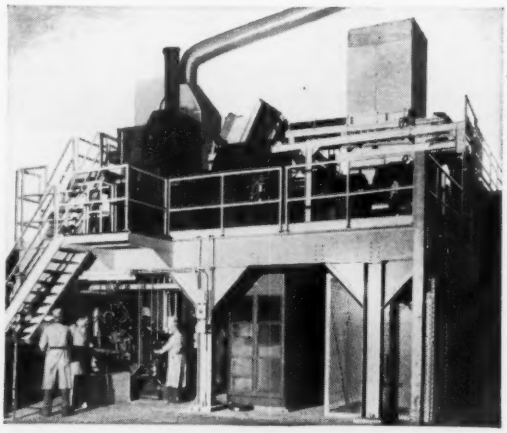

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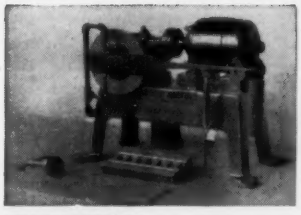

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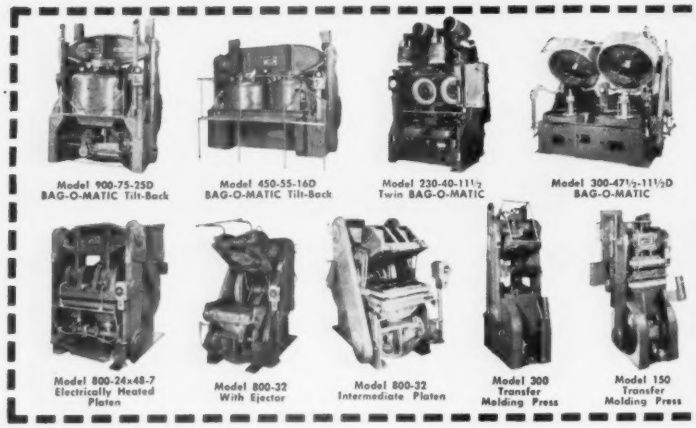
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200 Ton, Hymac, 16" Down Moving Ram, 30" x 30" Bed.
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